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ABSTRACT

The relationship between higher cognitive teacher questions and the nature of the cognitive thought processes involved in the student answers was investigated. Literature was reviewed, resulting in the selection of Blooms Taxonomy, and the Aschner and Gallagher, Smith and Meux systems for classifying higher cognitive thought processes. A pilot study followed, to aid development and refinement of procedures used in the main study which reanalyzed raw data from Minicourse 9 (a set of training materials designed to train teachers of elementary and junior high school students in higher cognitive questioning strategies). The appropriateness of students' responses, relationship between clarity of teachers' questions and clarity of students' answers, and type of student responses were studied. Results indicate that, despite five weeks of training, the correspondence between students' answers and teacher questions was only 53%. It is a possibility that inadequate training time or methods may account for this. Another reason may be that students did not have a common frame of reference with teachers, thus, student training in the use of appropriate cognitive processes may counteract the deficiency. Appendixes contain outlines of the three classification systems, stimulus passages, coded transcript sample, and coder reliability data. (Author/AEF)

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THE RELATIONSHIP BETWEEN TEACHER QUESTIONS AND STUDENT ANSWERS IN DISCUSSIONS

Final Report

Stephen R. Mills
Carol Rice
David C. Berliner
Beatrice A. Ward

REPORT A78-15

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Far West Laboratory for Educational Research and Development

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FAR WEST LABORATORY
FOR EDUCATIONAL RESEARCH AND DEVELOPMENT

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INTRODUCTION

As a function of the extensive experience Laboratory personnel had with the questioning behavior of teachers, members of the staff became interested in the nature of the cognitive thought processes involved in students' answers to the different kinds of questions to which they responded. It had been felt that outcomes which related to the nature or characteristics of student answers, qua answers, were all but neglected in favor of more traditional outcomes like academic achievement measured by some test instrument requiring written responses. Consequently, it was felt that studies were needed which more thoroughly delineated the relationship between what were called higher cognitive questions and the higher cognitive responses they were supposed to affect. Such studies, it was hoped, would lay the groundwork for the eventual development of more effective "thought-oriented" teacher questioning strategies.

With this perspective the Laboratory developed a proposal in which it was recognized that only a limited amount of time and funds could be allocated for a teacher-question/student-answer study. It was decided that the research effort could best be accomplished by a re-analysis of the large amount of raw data that had been collected as part of the main field test of Minicourse 9, a multimedia set of training materials designed to teach teachers how to ask higher cognitive questions (see Gall, Dunning, Galassi, and Banks, 1970). It was felt that this approach would serve the purpose of adding to the store of knowledge about higher cognitive questioning, while obviating the necessity for expensive and time-consuming classroom data gathering. A strategy for carrying out the study was then devised which involved a three-stage process.

First, a literature review would be conducted to determine what was known about teacher higher cognitive questioning and its effects on student verbal responding, and to select classification systems which could best be applied in studying higher cognitive thought processes.

Next, a pilot study would be conducted for the purposes of developing and refining procedures for coding raw data, training coders, and checking coder reliability.

Finally, the main study (the reanalysis of the Minicourse 9 teacher questioning data) would be conducted in an attempt to characterize students' verbal responses to various types or levels of higher cognitive questions.

The original proposal between the Laboratory and the National Institute of Education called for an investigation of the relationship between teachers' questions and students' answers in terms of the following four dimensions:

a) the appropriateness of students' responses;

b) the complexity of students' responses;

c) whether students' provided evidence, gave opinions, made creative responses, criticized, analyzed, etc.;

d) the linguistic characteristics of students' responses, e.g., the number of words in their answers, the number of sentences, connectives, nouns and qualifiers.

In addition to these dimensions, it was proposed that the study "check" on existing schemes for classifying questions to see whether various cognitive processes were engaged in by the learner as a function of exposure to various types of questions asked by the teacher.

After an extensive review of the literature was completed on student outcomes related to teacher questioning, a careful re-appraisal of the proposal was made and the original dimensions of the study modified to reflect the current research findings. These modified dimensions were as follows:

a) *The appropriateness of students' responses would be investigated*. The term "appropriateness" would denote that a logical relationship or logical connection existed between students' answers and teachers' questions. For example, if a teacher's question logically demanded that an *explanation* for some event, attitude, condition, etc., be provided, then a student's answer must necessarily have constituted such an explanation to be considered an "appropriate" response. Thus, for responses to be appropriate means that a logical relationship holds between the cognitive demands of the teacher's question and the cognitive components of the student's answer, regardless of the specific cognitive processes which are being utilized, i.e., analysis, inference, evaluation, statement of facts, etc.

b) *Studying the complexity of students' responses would be dropped in favor of investigating the relationship between the clarity of teachers' questions and the appropriateness and clarity of students' answers*. This would be done for the following reasons--

   1) no consensus could be found in the literature with regard to defining *complexity* since the definitions offered ranged widely from the *number of words in an answer* to the *number of mental operations required*;

2) no clear-cut relationship was established in the literature between response complexity and the quality of students' answers;

3) a pilot study revealed that the quality of students' answers seemed to be a more practically meaningful dimension than complexity per se, especially when "quality" could be defined in terms of the appropriateness and clarity of students' answers.

c) Whether students provided evidence, gave opinions, made creative responses, criticized, analyzed, etc. would be investigated. The significance of students' use of these cognitive processes, however, would depend on whether or not they were employed in the context of providing appropriate responses to analogous types of teacher questions.

d) The linguistic characteristics of students' responses, i.e., number of words, sentences, connectivenes, nouns, etc. would not be investigated. These characteristics of students' answers were judged to offer a "low payoff" towards understanding the relationship between teacher questions and student answers. The reason for this viewpoint was two-fold:

1) such elements as nouns, verbs, and stems (opening words) were found to be poor predictors of the logical operations involved in providing appropriate answers to various types of teacher questions (Smith, Meux, 1962), and

2) the number of words, sentences, or qualifiers contained in students' answers were considered to be, at best, only rough indicators of the quality of students' responses (Gall, 1970).

e) At least three existing schemes for classifying the cognitive processes used by teachers and students would be investigated. This would be done in order to determine the efficiency of such schemes in characterizing or accounting for a wide variety of teacher questions or student answers, as well as to explain any variance in student response appropriateness due to peculiarities or characteristics within each classification scheme.

The study that follows is based on the decisions outlined above.

REVIEW OF THE LITERATURE

The research on higher cognitive questioning has been divided into five general groups:

Group one involves studies which provided useful background information on higher cognitive questioning and on the cognitive classification systems used to describe higher cognitive questions.

Group two involves studies which investigated the relationship between the use of higher cognitive questions and student achievement outcomes.

Group three involves studies which investigated the relationship between special instructional settings and the use of higher cognitive questions.

Group four involves studies which investigated the relationship between special training and teachers' use of higher cognitive questions.

Group five involves studies which investigated the relationship between higher cognitive questions and types of student answers.

As noted above, studies in the first general group provided background information on higher cognitive questioning and on classification systems used to analyze higher cognitive thinking. Within this general group, four distinct subgroups emerged. These are discussed briefly below.

System development studies. This subgroup contains works which developed various categories for classifying the thought processes manifested in teacher/student dialogue (Guilford, 1959; Smith, Meux, et al., 1962) or implied by behavioral objectives (Bloom, 1956). The classification systems concerned with "thinking" became known respectively as the Guilford Structure of Intellect Model, the Smith and Meux Logic of Teaching System, and the Bloom Taxonomy of Educational Objectives. While other cognitive classification systems have been developed, only these three seemed sufficiently well thought out as to offer the possibilities of becoming adequate research tools for studying student answers to teacher questions.

One other system, Guszak's (Guszak, 1968), was considered adequate as a possible research tool since it was an amalgamation of categories covered in Bloom and Guilford. But because it had not been used very often, it was not studied further. The studies to be reported on, therefore, employed either the Bloom, Guilford, or Smith and Meux systems in analyzing higher cognitive thought.

Adaptation studies. These consisted of works which adapted or modified the three germinal cognitive classification systems for use by teachers or researchers. Aschner, Gallagher (1965) adapted the Guilford model for research purposes in teacher questioning studies; Fuller (1968) adapted the Smith and Meux system for teacher use in the area of reading comprehension; Meehan (1970) developed cue word examples for teachers in each of the Bloom and Guilford (Aschner-Gallagher modification) categories; and Sanders (1966) developed question and answer examples for each level of a slightly modified Bloom Taxonomy.

Verification studies. These studies provided evidence which substantiated, to some degree, the hierarchial structure of the Bloom Taxonomy (Kropp and Stoker, 1966; Madaus, Woods, Nuttall, 1973).

Literature review and prescriptive studies. These works presented literature reviews relating to the state of the art in higher cognitive questioning and offered proposals and recommendations for further research (Clegg, Manson, Ochoa, Nichols, and Williams, 1969; Davis, Morse, Rogers, and Tinsley, 1969; Gall, 1970; 1973). Some of the most salient conclusions stated or implied in these studies were:

- teacher questioning is the basic unit underlying classroom teaching;
- the great majority of teachers ask questions at a low intellectual (cognitive) level, i.e., the questions are at the level of memory or recall facts;
- teachers should increase the intellectual levels of their questioning in order to foster higher intellectual thought in their students;
- cognitive classification systems seem useful as training devices for developing teacher questioning strategies which stay at higher intellectual levels.

From this initial group of studies an interesting phenomenon was noted. Many of the investigators studying higher cognitive thought processes seemed to be fond of divising their own cognitive classification systems. This resulted in there being very little perceived comparability between studies. Integrating the findings of research using, for example, simplified, general categories, with the findings of research using more complex, detailed categories, presented a problem. The focus in this literature review was on those studies which explored higher cognitive thought processes using the more detailed analytical systems. The reason for this choice was twofold:

- it seemed important that the systems have a sufficient number of categories so that a wide variety of thought processes could be described and classified; and
- it seemed necessary that the systems' categories be defined in sufficient detail and include enough examples that training coders to reliably use the categories in a reasonable (preferably short) period of time would be possible.

As a result of selecting these criteria, studies employing cognitive classification systems which were vaguely defined or which contained too few categories (i.e., Bellack, Kliebard, Hyman, and Smith, 1966; Massialas, 1970; Sprague, 1971; Taba, Levine, and Elzey, 1964) were excluded from discussion.

Based on the criteria derived from the background studies, studies in the second general group--investigations of the relationship between higher cognitive questioning and student achievement--were reviewed only when they satisfied those criteria. These included studies by Buggey (1972), Clegg and Sebolt (1970), Hunkins (1967; 1968), and Rogers and Davis (1970), all of whom investigated social studies achievement using the Bloom Taxonomy. In addition, Ladd (1969) studied earth science achievement using inquiry teaching methods classified according to the Smith and Meux system. The basic approach in all these studies involved exposing students to learning materials or questioning strategies designed to encompass various cognitive levels. Then, after a convenient period of time had elapsed, students were tested to ascertain whether or not specific higher cognitive teaching strategies produced increased learning.

The conclusion reached in most of the studies was that students who had been exposed to higher cognitive questioning experiences attained higher achievement scores than students who had not been so exposed. Unfortunately, these findings were not always reliable. Some of the studies suffered from methodological problems (for example, Hunkins used inappropriate higher cognitive achievement measures) while others could not replicate the effect (for example, Rogers and Davis found insignificant achievement differences between experimental and control groups).

Group three studies that were reviewed investigated teacher questioning levels involved in process-oriented versus content-oriented social studies classes (Tinsley, Watson, Marshall, 1970) and in reading classes

(Guszak, 1968). Both found teacher questioning to be at low intellectual levels requiring predominantly recall or memory response. In addition, Tinsley, Watson and Marshall found no significant differences between process-oriented and content-oriented classes--a finding which tends to dispell the assumption that teachers using the process or inquiry approach to learning necessarily ask more higher cognitive questions.

Studies in the fourth group focused on the effects of special training on increasing teachers' use of higher cognitive questions. Although all the studies that were reviewed employed the Bloom Taxonomy as their higher cognitive questioning model, various approaches were devised to train teachers including a five-week Minicourse (Gall, Dunning, Galassi, and Banks, 1970), eight weekly individual and group sessions (Farley and Clegg, 1969), several daily seminars (Rogers and Davis, 1970), and one 2-hour seminar (Willson, 1973). At the end of these training periods, the teachers' levels of questioning were measured and compared to those of teachers who had received different or no training in questioning at all. The investigators found, in all cases, that the levels of questioning for trained teachers were significantly higher than those for untrained teachers.

Studies in the fifth and final group analyzed relationships between teacher questions and student answers. These studies were of particular interest not only because they employed cognitive classification systems which satisfied the two selection criteria derived from the group one studies but they also were the only ones to include data on the types of student answers which resulted from higher cognitive questioning.

Gallagher, Aschner, and Jenné (1967) investigated the thought processes of 176 gifted junior high school students and their teachers using the

Aschner-Gallagher system. Five classes (2 in social studies, 2 in science, and 1 in English) were observed and tape recorded on five separate occasions in the fall and again the following spring. Some of the more pertinent findings from this study indicate that the proportion of lower and higher cognitive questions asked by teachers on given days varied though the discussion material used was held constant. For example, the number of higher cognitive questions asked by one social studies teacher over a one-week period fluctuated considerably with the mean percentage of questions in the Aschner-Gallagher categories of cognitive-memory, convergent thinking, divergent thinking, and evaluative thinking varying from 40 to 75, 15 to 43, 3 to 8, and 2 to 16 percent, respectively. In addition, the proportion of teacher questions asked at higher cognitive levels varied according to the subject matter being discussed. The mean percentage of higher cognitive questions asked was 33 for social studies, 40 for science, and 48 for English. The overall proportion of higher cognitive questions asked by the teachers in the study was 41%. While these teachers were working with gifted students, this figure appears to be about the same as that reported in other studies of teachers of non-gifted students (see Table 1). It should be noted, however, that the comparisons in Table 1 are suggestive only since grade level of students, subject matter, and methods used to classify cognitive thinking differed across the studies.

Finally, in the Gallagher, et al., study, gifted students depended on the proportion of lower and higher cognitive questions asked by teachers. For example, teachers asked more cognitive-memory questions than all other questions combined (58 percent) and 46 percent of the students' answers were at this level. Teachers asked 5 percent divergent thinking and 6

TABLE 1

Mean Percentage of Higher Cognitive Questions Asked by Teachers of Non-Gifted Students

Investigator	Date of Study	Percent Higher Cognitive Questions Asked
Stevens	1912	33
Haynes	1935	23
Corey	1940	29
Davis & Tinsley	1967	39
Farley & Clegg	1969	69
Gall, et al.	1970	49
		Mean = 40

percent evaluative thinking questions; student responses were 8 percent and 7 percent in each category.

Conclusions which may be drawn from these findings include:

- a stable point estimate of the number of higher cognitive questions asked can best be obtained by sampling either a large number of teachers or else a smaller number of teachers under a repeated measures design;
- the academic subject matter being taught is a possible source of variation influencing the number of higher cognitive questions asked by teachers;
- the teachers of gifted students can be expected to ask about the same number of higher cognitive questions as the teachers of non-gifted students;
- the cognitive levels of students' answers are largely determined by the cognitive levels of teachers' questions.

The study by Gall, Dunning, Galassi, and Banks (1970), used the Bloom Taxonomy adapted to a microteaching format to train 54 teachers (grades 4 to 8) for five weeks in the use of higher cognitive questions. The pre- and post-training performances of these teachers were recorded and compared to the performances of 24 control teachers. Performance data were also obtained for the students of both groups. For both trained and untrained teachers, a significant linear relationship existed between students' grade levels and the cognitive levels of teachers' questions. That is, as the grade level increased, the average number of higher cognitive questions asked increased. At grade 4, the mean percentage of higher cognitive questions asked by teachers was 39 before training and 59 post-training. For grade 5, the mean percentages were 48 pre and 66 post; grade 6, 46 pre and 68 post; grades 7 and 8, 64 pre and 73 post. For the students of trained teachers, the mean percentage of higher cognitive answers increased significantly from 52 to 70 percent. As noted in Table 2, for both trained and untrained teachers, the mean percentage of lower and higher cognitive student answers given closely matched the mean percentage of teacher questions asked.

TABLE 2

Percentage of Questions and Answers for Each
Cognitive Level Defined by the Bloom Taxonomy
Reported in Gall, et al., Study

	Pre Training		Post Training	
Cognitive Category	Percent Questions	Percent Answers	Percent Questions	Percent Answers
Knowledge	51	48	34	30
Comprehension	3	3	5	5
Application*	-	-	-	-
Analysis	21	21	27	28
Synthesis	9	10	12	15
Evaluation	16	18	22	22

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* This category was not used in the Gall study.

Conclusions which may be drawn from the Gall, et al., findings are:

- students' grade levels are a probable source of variance influencing the type (cognitive level) of questions teachers ask in the classroom;
- teachers trained in higher cognitive questioning will ask their students significantly more of this type of questions than will untrained teachers;
- the students of trained teachers will give significantly more higher cognitive answers than will the students of untrained teachers;
- the cognitive levels of student answers closely match the cognitive levels of teacher questions.

Willson (1973), setting out to study the relationship between the thought levels of teachers and their pupils, trained 12 social studies teachers (grades 2, 5, and 6) in the use of the Bloom Taxonomy using 2-hour individualized feedback sessions. Both before and after this training, tape recordings were made of teachers holding classroom discussions with their students. These were compared to the recorded discussions of 13 control teachers. Willson's data analyses showed that the mean cognitive level of questioning for trained teachers was higher than that for untrained teachers and the mean cognitive level of answers for the students of trained teachers was higher than that for the students of untrained teachers.* Despite the high correspondence between questions and answers when expressed in terms of the percent of total frequencies in each cognitive category (i.e., Gallagher, et al., and Gall, et al.), the frequency of one-to-one correspondences was much lower in the Willson study and, in fact, varied considerably depending on the cognitive category involved (see Table 3).

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* Although both findings were reported by Willson as statistically significant, the test statistic used (Student's t) was probably inappropriate since the raw scores (in the form of Boom cognitive categories) represented nominal data. It was considered more conservative, therefore, to report the results as stated above.

TABLE 3

Percentage of One-To-One Corresponding Questions and Answers for Each Cognitive Level Defined By the Bloom Taxonomy

Cognitive Category	Percent question/answer correspondences*
Knowledge	64
Comprehension	70
Application	26
Analysis	44
Synthesis	31
Evaluation	22

The data reported in Table 3 suggest that there appears to be far less correspondence between level of teacher questions and level of student answers as one goes "higher" in the Bloom Taxonomy. This conclusion was not drawn by Willson, however, probably because his correspondence data remained in the form of raw frequencies. Instead, he came to the somewhat mystifying conclusion that "redirecting questions toward higher levels increases pupil participation to a more satisfying level" (Willson, p. 428).

Conclusions which may be drawn from the Willson findings include

- teachers trained in higher cognitive questioning can be expected to ask more of this type of questions than untrained teachers;
- the students of trained teachers can be expected to give more higher cognitive answers than the students of untrained teachers;
- the cognitive levels of students' answers cannot be determined simply by looking at the cognitive levels of teachers' questions since the degree of correspondence between the two may vary.

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* Calculated from data presented in Willson's study, p. 428.

Since this last finding conflicts with the findings of Gall, et al. and Gallagher, et al., a question arises about the results of these studies. Consider the following illustration of the problem: Suppose a teacher asks five questions which are classified in cognitive category A. The students, however, respond with five answers which are classified in cognitive category B. The teacher then goes on to ask five questions in category B, but gets five answers in category A. Using the percent total frequency method employed by both Gall and Gallagher, the following result would be obtained:

Cognitive Category	Percent Teacher Questions	Percent Student Answers
A	50	50
B	50	50

Although there would seem to be a perfect correspondence between questions and answers for each cognitive category, this, of course, is a totally misleading result. Using the one-to-one correspondence method suggested by Willson's raw frequency data, the following result would be obtained:

Cognitive Category	Percent Question/Answer Correspondences
A	0
B	0

Since this latter outcome accurately describes the data, the conclusion is that the one-to-one correspondence method is the more appropriate one for determining the relationship between teacher questions and student answers.

Accepting the one-to-one correspondence method as the more suitable, the question still remains: Why did Willson's data show a lower than expected correspondence between questions and answers at higher cognitive thinking levels? One possible explanation involves the grade levels of the students used in the sample. Taking a Piagetian point of view, it could be argued that since second and fifth graders are at the concrete-operational stage of thinking, they probably had difficulty responding to higher cognitive questions which required formal-operational thought. The implication here is that the second and fifth graders' lack of cognitive development may have lowered the performance of Willson's entire sample at higher cognitive levels.

Another possible explanation involves the amount of training in higher cognitive questioning the teachers received. The 2-hour session Willson provided represented a minimal amount of training when compared to the days (Rogers & David; Farley & Clegg) or weeks (Gall, et al.) of training provided by other investigators. The assumption here is that teachers' lack of experience in formulating clear and suitable higher cognitive questions caused the lower student performance.

Still another explanation involves the characteristics of the cognitive classification system used. It is possible that the lack of question/answer correspondence at higher cognitive levels was due to idiosyncracies of the Bloom Taxonomy in describing types or levels of cognitive thought. The inference here is that different systems used to classify the same teacher/student dialogue may produce different results.

Literature review summary and focus of the study

In reviewing the literature on higher cognitive questioning, only a handful of studies were found which looked at the student outcomes resulting from teacher questioning strategies. Of this handful of studies, however, the majority focused on standard academic achievement in social studies, earth science, etc. (Buggey, 1972; Clegg & Sebolt, 1970; Hunkins, 1967, 1968; Ladd, 1969; Rogers & Davis, 1970), while only a small number concentrated on the nature of student higher cognitive responses (Gallagher, et al., 1967; Gall, et al., 1970; Willson, 1973). Unfortunately, the investigators in these latter studies seemed content to make comparisons between the numbers of teacher questions and student answers which fell into various lower and higher cognitive categories in order to make inferences about student performance. As was pointed out previously, this type of analysis has little merit in that it tends to give the erroneous impression that there is a high correspondence between teacher questions and student answers. In addition, it does not able one to determine whether or not student answers exhibited the appropriate cognitive processes that the teacher's questions were supposed to elicit.

The fact that the majority of the studies reviewed either ignored or paid little attention to the nature of the students' higher cognitive responses seems to suggest that most of the investigators were under the assumption that a high correlation or high degree of correspondence existed between the type of teacher questions and the type of student answers given in response. Thus, it probably seemed logical to these investigators to focus on teacher performance outcomes and/or to go ahead and look at student achievement assuming, as they must have, that student performance in using higher cognitive thought processes was adequate (in keeping with the seeming adequacy of the teacher questioning).

That this assumption may be in error, however, is suggested by the reanalysis of part of Willson's data that was reported here (Table 3). This reanalysis showed a considerable variation in one-to-one correspondence between teacher questions and student answers (22% to 70% depending on the cognitive process category being scrutinized). This indicates that Willson's teachers were getting, on the average, only about 43% of their questions answered at cognitive levels appropriate to their questions. Thus, for example, a teacher who asked a number of questions requiring students to, say, analyze information could only expect about 43% of the student answers to reflect this type of cognitive thought process.

Because the appropriateness of students' responses seems to be so important in determining the effectiveness of teachers' higher cognitive questioning and because the average one-to-one question/answer correspondence was surprisingly low as initially determined from Willson's data, it was decided to limit the present research effort to an explication of the nature of this one-to-one correspondence. The goal of the present study, therefore, will be to confirm or disconfirm the question/answer correspondence results obtained from Willson's data by (a) reanalyzing some existing data in terms of the appropriateness of the cognitive category of students' answers; and (b) controlling for likely influencing variables which were unaccounted for in Willson's data, i.e., students' grade level, amount of higher cognitive teacher training, and type of cognitive classification system used.

METHODOLOGY

The discussion of methodology for the study reported herein covers eight main topics. The research questions derived from the review of the literature and a pilot study of the Gall, Dunning, Galassi, and Banks (1970) data base are presented. The data base and pilot study are described. The design for data analysis is presented. The instruments and coding procedures used in the secondary analyses are described. Coder training and coder reliability are reviewed.

Research Questions

On the basis of the literature review and pilot study (see discussion later in this section of the report), the following research questions were formulated concerning the nature of the relationship between higher cognitive teacher questions and the student answers elicited and became the focus of this study. They are:

1. What is the actual degree of correspondence between the cognitive level of teachers' questions and the cognitive level of students' answers? To what extent does the degree of correspondence vary as the cognitive level of teachers' questions varies?

2. Does the correspondence between the cognitive level of teachers' questions and the cognitive level of students' answers depend on:

    a. the specific cognitive system used to classify teacher/student dialogue?

    b. the degree of applicability of a cognitive system's categories in describing or characterizing teacher/student dialogue?

    c. the intellectual maturation (cognitive development) of students as indicated by grade level?

    d. interactions between the cognitive system used, the applicability of cognitive categories, and student maturation (grade level)?

    e. the amount of training teachers receive in higher cognitive questioning?

The degree of correspondence between questions and answers was investigated in terms of the number of student answers which were classified in the same cognitive categories as the teacher questions which elicited them. This seemed justified because what needed to be determined was the number of answers which were given in appropriate categories specifically asked for by the teacher, rather than merely the number of answers which fell in any higher cognitive category (see argument in previous discussion of Willson's study). Thus, if a teacher asked an analysis question, for example, a student's answer given in the evaluation or the synthesis category was not considered appropriate since the teacher did not specifically ask for this type of response. Only a student response given in the same cognitive category (i.e., analysis in this case) was counted as a corresponding answer.

Data Base

As noted above, the data used in the present study were obtained previously by Gall, Dunning, Galassi, & Banks (1970). The main purpose of their study was to determine whether Minicourse 9: Higher Cognitive Questioning (described below) accomplished the teacher training performance objectives outlined in the course when used under field test conditions. These objectives basically were: (1) teachers who had taken the course would ask significantly more higher cognitive questions than teachers who had not taken the course, and (2) students of teachers who had taken the course would give significantly more higher cognitive answers than students of untrained teachers.

Sample. Seventy eight elementary (grades 4-6) and junior high (grades 7-8) teachers were recruited to participate in the study, 54 of whom were assigned to the experimental (treatment) group and 24 to the control (nontreatment) group. The assignment of teachers to these two groups was not done at random but rather on the basis of willingness to undergo five weeks of Minicourse training.

Treatments. The experimental group received training in higher cognitive questioning via Minicourse 9--an instructional package developed by the Far West Laboratory around the categories of the Bloom Taxonomy (see Review of Literature). The minicourse used materials which included teacher handbooks and instructional videotapes or films. The training was carried out over a period of five weeks with teachers completing their lessons at a rate of one per week. Each lesson sequence usually consisted of the following steps: Day 1, read the appropriate handbook chapter and view the corresponding instructional videotape; plan a microteaching session using a small group of students (5-10) in order to practice the lesson skills; Day 2, conduct the microteaching session and record what transpires on videotape, play back the videotape and analyze any discrepancies between lesson objectives and actual performance, plan a reteaching session; Day 3, conduct the reteaching session and record what transpires on videotape, play back and analyze the videotape as before. The next week, these procedures are repeated for the next lesson and so on until all lessons are completed.

The control group received no training nor any special instruction during the time the experimental group took Minicourse 9.

Data collection. To determine the relative effectiveness of the experimental and control conditions, pre- and post-measures of each teacher's discussion behavior were recorded. The basic procedures used are described by Gall et al., as follows:

> One week prior to the start of the course, teachers in (both) groups were assigned a one-page standard stimulus article on which they were to conduct a 20-minute discussion with their classes. The articles were chosen so as to have the following characteristics: brevity, of interest to students, at the students' reading level, and containing a mixture of fact and thought-provoking materials. All 4-6th grade teachers received a one-page story on the wolf, adapted from Wildlife in Danger, by Ivah Green. All junior high teachers received a one-page article on the population explosion, adapted from a newspaper article on this subject. The teachers were asked to have their students read the article a day prior to the audiotaped discussion, with no intervening discussion. One week after the course had concluded, teachers were given another standard stimulus article on which to base a discussion. The 4-6th grade teachers received a story on the grizzly bear, adapted from the same source as the story about the wolf. All junior high teachers received an article on environmental pollution, adapted from a newspaper article on the subject.* An attempt was made to make the pre-post pairs of articles (wolf and bear; population and pollution) as equivalent as possible on the dimensions described above (brevity, interest, etc.).

To facilitate later scoring of discussion behaviors, typed transcripts were made of all audiotape recordings. Typists were instructed to transcribe all discourse that occurred. They were also instructed to indicate undecipherable discourse by a series of dots.

Because it was considered difficult to obtain good audio recordings for an entire classroom, teachers were asked to randomly select half their classes for inclusion in the sample by choosing the 1st, 3rd, 5th, etc. students from their class rosters. The same students were used for the pre- and post-course tapings.

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* A copy of each post-course stimulus article can be found in Appendix A.

The Pilot Study

Before the design for analysis of data in the study reported here was finalized, a small pilot study was conducted on a sample of the raw data obtained from the Gall et al., study.

From the total data bank of 156 typed transcripts--78 teachers (experimental and control) x 2 observations (pre and post), 10 transcripts were chosen at random by selecting those whose pre-assigned identification numbers coincided with the first 10 numbers read from a table of random digits. The teacher/student dialogue on these transcripts was then evaluated using three different cognitive classification systems. From this evaluation, decisions were made regarding methods for setting up the data, training coders, and checking coder reliability for the present study. See Data Analysis section for details.

In addition to this evaluation, in the course of carrying out the pilot study, two things were noticed about the sample of raw data which had important implications for the analysis of data.

First, many of the transcripts consisted of discussions in which higher cognitive categories were only infrequently required to classify the teacher and student dialogue; in other words, they stressed low cognitive content. On cross checking with a master I.D. sheet, it was noticed that the transcripts having the largest amount of low cognitive discussions belonged to teachers untrained in Minicourse 9 (control teachers and experimental precourse teachers).* In addition, the amount of time required to code a complete transcript using only one cognitive classification system ranged from 1 1/2 to 2 hours. Although it was estimated that a somewhat shorter time interval might be needed by trained and practiced coders, it was obvious that a large amount of time would be required to code all 156 transcripts using several different coding systems per transcript. It was therefore decided to limit the transcripts of interest in this study to those of the experimental post-course teachers (a total of 54). In this way, it was hoped to maximize the possibility of obtaining transcripts with large amounts of higher cognitive dialogue and, at the same time, reduce the amount of time necessary to code the data.

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* This observation tends to reinforce the findings of previous studies which found predominantly lower cognitive questioning associated with untrained teachers.

The second thing noticed from the sample of raw data was that the degree of difficulty in assigning cognitive categories to the transcript dialogue varied considerably. For example, some teacher questions and student answers were classified readily while others necessitated a great deal of thought and discussion, definition checking, and inference making before suitable cognitive categories could be found. Furthermore, complex questions and answers were typically assigned two (and sometimes three) categories in order to adequately describe or characterize the statements. Such classification problems were mentioned in only one* of the studies reviewed previously--almost leading one to believe that the cognitive categories used in previous studies were at all times perfectly descriptive of the teacher/student dialogue (an extremely unlikely occurrence). It was decided, therefore, that in evaluating transcripts for the present study, coders would be required to use both a classification system and an accompanying rating scale such that each question and answer would be assigned a cognitive category (or categories) and a rating (or ratings) which could be used to signify the confidence of the rater with regard to the extent to which the assigned cognitive category characterized or described the question or answer being coded. This rating would constitute a rough estimate of the "goodness-of-fit" of the category. (For details regarding this rating scale, see the Data Analyses Design section which follows.)

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* Smith and Meux, p. 44, describe problems of category applicability in coding typed transcripts of classroom dialogue but offer no suggestions by which to eliminate or compensate for such difficulties.

Data Analyses Design

In terms of the research questions stated previously, the following methods of evaluation were used:

> Research question 1--the correspondence between questions and answers was measured by counting the number of student responses which were coded in the same cognitive category as the teacher questions which elicited them. The total number of such correspondences was ascertained for each cognitive category used by teachers in their 20-minute discussions.
>
> Research question 2(a)--the variability of question/answer correspondences across coding systems was measured by analyzing each of the 54 typed transcripts using three different cognitive classification systems (i.e., Bloom, Aschner-Gallagher, and Smith and Meux).
>
> Research question 2(b)--the variability of question/answer correspondences due to applicability of coding categories was measured by rating each of the categories assigned on a 4-point scale reflecting the raters belief in the appropriateness of that descriptive category. Dialogue classified with high ratings of category appropriateness (4s and 3s) were then compared to dialogue classified with low ratings (2s and 1s).
>
> Research question 2(c)--the variability of question/answer correspondences due to students' grade levels was measured by comparing the teacher/student dialogue for grades 4-6 (elementary) with that for grades 7-8 (junior high).
>
> Research question 2(d)--the variability of question/answer correspondences due to interactions of the cognitive system used, the applicability of the category, and grade level were measured by comparing teacher/student dialogue for all possible permutations of the above.
>
> Research question 2(e)--the variability of question/answer correspondences due to amount of teacher higher cognitive training was

> measured by comparing the Minicourse 9 data (for grades 4-6, coded by the Bloom Taxonomy) with the corresponding data obtained in the Willson study. The data for grades 4-6 based on the Bloom Taxonomy were used because they most closely approximated Willson's data which were based on grades 2, 5, and 6.

The basic unit of comparison in the above analyses was the _percent of one-to-one correspondence_ between teacher questions and student answers. This percent value was determined by dividing the one-to-one correspondence frequency for each cognitive category by the total number of teacher questions appearing in the same category. For example, suppose 100 teacher questions were classified as cognitive process X, while 75 of the student answers elicited by these questions were classified in the same category (the remaining 25 being classified in other categories). The degree of question/answer correspondence for cognitive process X would be reported as _75%_. Note that the higher the degree of cognitive correspondence between a teacher question and a student answer, the higher the reported percentage would be.

In using the percent correspondence as the unit of comparison, a descriptive approach to analyzing the Minicourse 9 data rather than a statistical significance testing approach was used. This choice seemed justified because the purpose of the study was to show what the actual question/answer correspondence for each cognitive process was when possible influencing variables like grade level, type of category system, and category appropriateness were accounted for. Furthermore, the importance of the _size or degree_ of correspondence for each cognitive process seemed to be largely a matter for individual evaluation and judgment since any deviation between expected and observed frequencies for questions and answers would undoubtedly be significant given the large number of teacher question frequencies expected (e.g., an average of 289 questions per cognitive category were obtained by Willson).

Figure 1 summarizes the data analyses approaches used in the study.

In summary, the data analyses considered:

- The overall percent correspondence for each descriptive category in a system, A, B, C, D, E, ... etc., was determined--Research question 1.
- The percent of correspondence for each category was compared by grade (elementary vs. junior high)--Research question 2(c).
- The percent correspondence for each category was compared by appropriateness rating (4 or 3 vs. 2 or 1)--Research question 2(b).
- The percent correspondence for each category was compared by grade and by rating, simultaneously--Research question 2(d).
- All of the above analyses were repeated for each of the three cognitive classification systems employed in the study (Bloom, Aschner-Gallagher, Smith and Meux)--Research questions 2(a) and 2(d).
- The elementary grade data providing the percent of correspondence between teacher questions and student answers when using the Bloom cognitive classification system were compared to the corresponding data for Willson's study--Research question 2(e).

Instruments

The verbatim transcripts of the experimental teachers' classroom discussions were analyzed using three cognitive classification systems--the Bloom Taxonomy, the Aschner-Gallagher system, and the Smith and Meux system. As was mentioned previously, these systems were selected specifically because they (a) contained a wide variety of thought process categories, and (b) contained sufficient description and examples for each category.

Since the categories of the Bloom Taxonomy were developed for the purpose of describing educational objectives (Bloom et al., 1956), the instrument was not well suited for coding teacher/student verbal interactions. Because of this, an adaptation of the Taxonomy by Brown, Ober, Soar, & Webb (1968)

FIGURE 1

Basic Scheme for Analyzing the _Minicourse 9: Higher Cognitive Questioning_ Data Using Selected Cognitive Classification Systems

Question/Answer Frequency Matrix

Student answers

Teacher questions

Cognitive categories	A	B	C	D	E	.... etc.	
A	Ⓧ						Σ row A
B		Ⓧ					Σ row B
C			Ⓧ				Σ row C
D				Ⓧ			Σ row D
E					Ⓧ		Σ row E
.						. .	
. . . etc.						. . . . . etc.	Σ etc.

where A,B,C,D,E.,,,etc. = descriptive categories within a given cognitive classification system

Ⓧ = frequency of one-to-one corresponding questions and answers for a given descriptive category

Σ row A,B,C, etc. = the total number of student answer codes corresponding to teacher questions in cognitive category A,B,C, etc.

percent correspondence = $\frac{\textcircled{X}}{\Sigma \text{ row}}$ = number of correspondences for a given descriptive category divided by the total number of teacher questions asked in the same category.

designed specifically for observing and coding classroom dialogue and behavior was used. The categories* in this adapted instrument (The Florida Taxonomy of Cognitive Behavior) are basically the same as those in the Bloom Taxonomy and are given as follows:

1. Knowledge of specifics--read, spell, define.
2. Knowledge of ways and means of dealing with specifics--cite rules, methods, steps in a process.
3. Knowledge of universals and abstractions--state principles, laws, theories.
4. Translation--convert material from graphic to verbal form or vice versa.
5. Interpretation--give reasons, make comparisons/contrasts, show relationships.
6. Application--apply previous learning to new situation(s).
7. Analysis--make distinctions, point out particulars, show relationships among elements, check hypotheses with specific information.
8. Synthesis--reorganize ideas, produce unique idea or plan.
9. Evaluation--make judgment(s) based on external or internal criteria.

The Aschner-Gallagher system, based on the cognitive "operations" delineated in Guilford's Structure of Intellect model, was devised specifically for coding a wide range of verbal behavior via live observation, tape recordings, or verbatim transcriptions of tape recordings (Aschner, Gallagher, et al., 1965). The categories* used in this instrument are as follows:

I. Routine
    1. Management--give instructions, ask for show of hands, etc.
    2. Structuring--signal one's next moves or remarks or those of others, forecast future activities.
    3. Verdict--give praise or reproach, accept or reject content.

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* See Appendix B for a more complete description of the categories.

II. Cognitive - Memory

4. Scribe--spell or exemplify a word or expression.

5. Recapitulation--quote, give literal reading, give nearly verbatim restatement.

6. Clarification--restate or rephrase in own words, add a "rider" or correction.

7. Factual--state facts or factual details.

III. Convergent Thinking

8. Translation--shift material from symbolic or figural to semantic form or vice versa.

9. Association--compare or contrast.

10. Explanation--justify a viewpoint, claim, or judgment with evidence or reasons.

11. Conclusion--generalize, summarize, draw a deductive implication.

IV. Evaluation

12. Unstructured--make a value judgment based on external or internal criteria.

13. Structured--conjecture, speculation, choose between alternatives.

14. Qualification--modify or oppose a prior value judgment.

V. Divergent Thinking

15. Elaboration--develop a previous point by concocting instances or examples.

16. Divergent Association--make unexpected comparisons or analogies.

17. Implication--extrapolate beyond given data, state hypothesis or possibility.

18. Synthesis--integrate central idea with an entirely new point or frame of reference.

Smith and Meux, et al. (1962) developed a cognitive classification system in the course of studying the logical structure of verbal interactions between teachers and students. Although the categories they developed seem to be narrower in focus than those in the Bloom or Aschner-Gallagher systems (i.e., the categories seem more descriptive of dialogue in planned instructional lessons than in more general or open-ended discussions), they, nevertheless, are of sufficient variety and offer sufficient description and examples to make them of interest to the present study. The set of 13 categories* comprising the Smith and Meux system are as follows:

1. Defining--state meaning of terms.
2. Describing--give factual details or examples.
3. Designating--identify something by name.
4. Stating--give formal conclusions, rules, steps in proofs, etc.
5. Reporting--give nearly verbatim review or summary of information written in a text.
6. Substituting--perform a symbol transformation usually mathematical.
7. Evaluating--state the worth, dependability, desirability of something.
8. Opining--make an inference (conjecture) about the thoughts, attitudes, or feelings of others.
9. Classifying--assign objects to a class, group, set, type, etc.
10. Comparing and contrasting--show similarities or differences between objects.
11. Conditional inferring--given an antecedent (cause), tell what the consequent (effect, outcome) is.
12. Explaining--given a consequent (effect or outcome), tell what the antecedent (cause) is.
13. Directing and managing classroom--non "content" classroom dialogue and activities.

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* See Appendix B for a more complete description of the categories.

A rating scale was developed by the research team and used to assess the appropriateness of the cognitive categories in the various systems for describing or characterizing teacher/student dialogue. The ratings ranged from 1 through 4 and are described as follows:

4--some part of the description or some example fits the question/answer so well that the category's appropriateness is immediately obvious (i.e., no inference is needed to apply this category).

3--some part of the description or some example fits the question/answer reasonably well so that the appropriateness of the category is likely (i.e., a small degree of inference is needed to apply this category).

2--although no part of the description nor any example fits the question/answer too well, the appropriateness of the category is inferred from a cue word or cue phrase obtained from the description (i.e., a moderate degree of inference is needed to apply this category).

1--although no part of the description nor any example fits the question/answer too well and no specific cues are apparent, the appropriateness of the category is inferred from the overall gist or meaning of the category's description (i.e., a great deal of inference is needed to apply this category).

Coding procedures

Procedures for coding transcripts were worked out in the pilot study--they involved four steps. First, three copies of the set of 54 transcripts (for experimental post-training teachers) were made and one copy was assigned to each of three groups of data coders (one group for each instrument mentioned above). Each coder group then proceeded to analyze their set of transcripts using one of the selected cognitive classification systems, i.e., coder group #1 used the Bloom Taxonomy, coder group #2 used the Aschner-Gallagher system, and coder group #3 used the Smith and Meux system.

In analyzing transcripts, coders assigned to each teacher question or statement and to each student answer or comment the cognitive category which they thought best described it. In cases where the teacher question or student answer was complex or overly general, such that more than one category was applicable, coders assigned any number of categories which they thought were necessary and appropriate. In addition, coders rated each category they applied on the scale from 1 to 4 as per the criteria mentioned above.* In the event that appropriate categories could not be found to describe questions and answers or in cases where the questions and answers were too vague or muddled, coders applied a "no category" (NC) designation.

After all coding was completed, each transcript was broken down into small units for analysis called episodes (after the methods advocated by Aschner, Gallagher, et al., and Smith, Meux, et al.). Each episode consisted of a teacher question or statement followed by the student answer(s) or comment(s) elicited. Teacher comments or concluding remarks which did not elicit further student responses were contained in the same episode as the preceding teacher question and student answers. As soon as a teacher posed a new question, made a different statement, or changed the focus of the discussion in some way, a new episode began.

Coder training

Because there were three different cognitive classification systems with difficult rules to be learned, in order to achieve mastery of the system it was decided that three distinct coder groups would be formed and each group would be trained separately. This necessitated maintaining a tight training schedule consisting of staggered training times and overlapping but independent group work.

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* See Appendix C for sample of coded transcripts.

For each coder group, the training was identical and involved a strategy of gradual transition from evaluating transcripts based on group consensus to evaluating transcripts based on individual judgment. The training went, roughly, as follows:

DAY 1: An introductory discussion was held in which the coding system to be used was described, the coding procedures outlined, and the performance standards (reliability criteria) specified. Materials containing descriptions and examples of the cognitive system's categories (see Appendix B) were handed out and the coders asked to read them over carefully. When each coder had finished studying the materials, a second discussion was held in which the cognitive classification system was gone over in detail until all initial questions were answered and all initial confusion cleared up. Next, a set of 28 mock teacher questions (see Appendix D), made up and pre-coded by the trainer and his assistant, was handed out. The coders were asked to practice applying the cognitive categories and rating scale by classifying each of the 28 questions and accompanying student answers on the basis of group consensus.

DAY 2: The categories and ratings assigned by the coders to the set of mock questions and answers were compared with those assigned by the trainer and his assistant. Discrepancies between the two evaluations were discussed in detail and corrected. Coders were then handed a complete transcript and asked to classify all teacher/student dialogue by applying cognitive categories and ratings on the basis of group consensus. This transcript and four others were carefully selected for training purposes from the group of control and experimental pretraining transcripts. They were selected on the basis of the degree to which the teachers utilized higher cognitive questions. Each of these transcripts was pre-coded by the trainers to verify codability.

DAY 3: The coders' group evaluation of the first transcript was compared with that of the trainers' and discrepancies between the two noted and resolved via a group discussion. A second training transcript was then handed out and the coders were instructed to evaluate it using the usual group consensus method.

DAY 4: The procedures followed on Day 3 were repeated. A group discussion of the previous day's coding was followed by handing out a third transcript for group evaluation.

DAY 5: After comparing the coders' and trainers' evaluation of the third transcript, a fourth transcript was handed out, one to each coder. The coders were then instructed to make individual evaluations without any communication with the other group members.

DAY 6: The degree of agreement between each coder's independent evaluation of the fourth transcript and that of the trainers was determined (see reliability section for method used). After discrepancies between evaluations were discussed and resolved, copies of a fifth and final training transcript were handed out and the coders told to evaluate them individually as before.

DAY 7: After insuring that there was a satisfactory level of agreement between individual coders and trainers on the fifth transcript, the coders were allowed to begin evaluating the 54 test transcripts. Coders were encouraged to solicit the opinions of the trainers and their fellow evaluators whenever a difficult judgment arose regarding the applicability of a cognitive category or the appropriateness of a rating.

Thereafter, until all transcripts were analyzed, weekly meetings were held with each coder group in order to check reliability and to discuss and resolve any problems encountered in evaluating transcripts.

Coder reliability

Nine persons (5 males and 4 females) were hired to evaluate the experimental post-training transcripts obtained from the field test of Minicourse 9. Of the nine, three were credentialed California teachers (unemployed at the time) and six were graduate students in psychology and education. Their ages ranged from 22 to 36 ($\overline{X}$=28). The coders were chosen, after careful interviewing, on the basis of their experience in teaching and/or experience in observing and coding classroom behavior.

In order to eliminate possible evaluation biases due to the selection of coding systems or selection of transcripts, the nine coders were randomly assigned for training to the three cognitive classification systems--three coders to the Bloom system, three to the Aschner-Gallagher system, and three to the Smith and Meux system. Likewise, each set of 54 transcripts was randomly assigned within a coding system as follows: for the Bloom system, coder #1 was randomly assigned 22 transcripts, 4 of which were replicated by coder #2, while another 4 were replicated by coder #3 (these replications were, of course, for reliability checking purposes); coder #2 was assigned 22 transcripts, 4 of which were replicated by coder #1 and another 4 by coder #3; and so on for coder #3. This random assignment was repeated for the other two coding system groups (Aschner-Gallagher and Smith & Meux).

The two major sources of coder unreliability which occur over time, i.e., lack of agreement with the original training criteria and lack of interrater agreement, were controlled, somewhat, through weekly meetings (mentioned previously) in which coding procedures and coding reliability were discussed and problems resolved.

Coder agreement with the original training criteria was maintained by going over individually evaluated transcripts with the group in order to clarify and standardize category definitions. Some adjustments in definitions were necessary from time to time but were only slight.

Interrater reliability was maintained by comparing the amount of cognitive category agreement between coders on the replicated transcripts. Any transcript in which the interrater agreement was not up to par was turned back to the coders for re-evaluation. As it turned out, this action was required only once during the entire data analysis for all three classification systems.

The amount of interrater agreement was determined by calculating the percentage of times two coders used the same categories to characterize teacher questions or student answers. A percentage or coefficient of agreement for each replicated transcript was then computed by applying a simple formula:

$$C_A = \frac{\Sigma A}{\frac{\Sigma X + \Sigma Y}{2}}$$

where C_A = the interrater reliability between 2 coders

ΣA = the total number of identical category assignments (agreements) between 2 coders

ΣX = the total number of categories assigned by coder X to the entire transcript

ΣY = the total number of categories assigned by coder Y to the entire transcript

To illustrate the calculation, suppose some coder X assigned a total of 90 categories to a teacher/student dialogue transcript, while another coder Y assigned 100 categories. (Note: the total number of assignments between 2 coders will not necessarily be equal because each may feel that a different number of categories is required to adequately describe particular teacher questions or student answers.) Now if 80 of the assignments made by coder X agreed with those made by coder Y, the interrater coefficient of agreement would be calculated as follows:

$$C_A = \frac{80}{\frac{90 + 100}{2}} = \frac{80}{95} = .84$$

If this coefficient or index of reliablity is multiplied by 100, the value obtained would be equivalent to 84%. This figure may be interpreted as the 2 coders having agreed 84% of the time in assigning cognitive categories to the same transcript.

It was determined beforehand that 80% agreement between any 2 coders would be an acceptable minimum performance standard since the data required making subjective judgments and inferences across a fairly large number of categories (from 9 to 18 depending on the cognitive classification system used).

Using the formula given above, interrater reliability coefficients were determined for each coding group and are presented in Table 4. Appendix E gives the between pair interrater reliability coefficients for each replicated transcript.

TABLE 4

Interrater Reliability Coefficients for Each Coding Group

Coding group	Coder 1 vs. Coder 2*	Coder 1 vs. Coder 3*	Coder 2 vs. Coder 3*	Overall**
Bloom	.85	.87	.85	.86
Aschner-Gallagher	.88	.82	.90	.86
Smith & Meux	.81	.76	.80	.79

---

* determined from 4 transcripts
** determined from 12 transcripts

Regarding the use of the rating scale, it was decided beforehand that a scale discrepancy between 2 coders greater than one value would be considered unacceptable. For example, if some coder X rated the applicability of a category describing a teacher question, say, as a 4, and another coder Y rated the category's applicability as a 4 or 3, the agreement between the 2 coders would be considered acceptable. If, however, coder Y rated the category as a 2 or 1, the agreement between the two ratings would be considered unacceptable. Disagreements between ratings in this latter case were resolved by going over the rating scale criteria with the coders and then having them re-evaluate the pertinent part(s) of the transcript. Coder agreement in applying the rating scale was very high. In only a few instances were the ratings off by more than one value. As a result, it is considered unnecessary to report reliability data for the rating scale agreement between coder pairs.

RESULTS

After all transcripts had been evaluated by the coders, using each of the three cognitive classification systems, the data were keypunched (one episode per card) and analyzed. A program of the Statistical Package for the Social Sciences was used to tabulate frequency data into cross-matrices.

Episodes classified as no category were not included in the summary data reported in Tables 5-7. Question and answer correspondence could not be computed of an episode if either the teacher or the student dialogue was unclassifiable.

On the basis of the results summarized in Tables 5, 6, and 7, the overall percent correspondence between teacher questions and student answers within each cognitive classification system was: Bloom Taxonomy, 51.3%; Aschner-Gallagher system, 56.1%; Smith & Meux system, 51.4%. Averaging these minor differences across different systems of coding provides an overall estimate of the average question/answer correspondence across categories. This esimate is 52.9%.

These data provide a basis for dispelling the belief that there is a high correlation between types of teacher questions and types of student answers. Since only approximately 53% of the student answers were appropriately addressed to the cognitive levels of the teacher questions, it seems that training teachers to ask higher cognitive questions in itself is not adequate to insure comparable levels of student performance.

Question/answer correspondences at lower and higher cognitive levels also were of interest. Table 8 summarizes the findings that are reported in Tables 5, 6, and 7 for the lower and higher cognitive categories for each coding system. While all three systems showed greater question/answer

TABLE 5

Percent One-to-One Correspondence Between Teacher Questions and Student Answers
Bloom Categories

	Categories	Overall	Grades 4-6	Grades 7-8	Rankings 1 or 2	Rankings 3 or 4	Grades 4-6		Grades 7-8	
							Rankings 1 or 2	Rankings 3 or 4	Rankings 1 or 2	Rankings 3 or 4
	No Category[1]	31.4	37.2	23.9	-[2]	-	-	-	-	-
Lower Cognitive	Knowledge of Specifics	79.2	86.2	68.5	59.6	82.8	67.9	89.1	50.0	72.7
	Knowledge of Ways and Means	45.4	60.0	41.2	14.3	60.0	50.0	66.7	0.0[3]	58.3
	Knowledge of Universals and Abstractions	-	-	-	-	-	-	-	-	-
	Lower Cognitive X̄ =	62.3	73.1	54.8	37.0	71.4	59.0	77.9	25.0	65.5
Higher Cognitive	Translation	33.3	26.3	40.0	23.5	40.9	33.3	23.1	18.2	66.7
	Interpretation	57.3	62.4	50.3	48.2	62.0	53.5	66.8	41.0	55.4
	Application[4]	-	-	-	-	-	-	-	-	-
	Analysis	41.9	46.2	38.9	27.8	61.5	33.3	50.0	26.7	100.0
	Synthesis	53.2	56.9	49.0	43.2	60.7	45.4	65.4	40.8	55.2
	Evaluation	48.7	49.2	47.9	49.5	47.7	49.1	49.2	50.0	44.4
	Higher Cognitive X̄ =	46.9	48.2	45.2	38.4	54.6	42.9	50.9	35.3	64.3
	Overall X̄ =	51.3	55.3	48.0	38.0	59.4	47.5	58.6	32.4	64.7

1. Not added to lower cognitive or higher cognitive mean correspondence totals
2. [-] = no teacher questions asked
3. [0.0] = teacher questions asked but no corresponding student answers given
4. Only one teacher question asked in this category

TABLE 6

Percent One-to-One Correspondence Between Teacher Questions and Student Answers Aschner-Gallagher Categories

	Categories	Overall	Grades 4-6	Grades 7-8	Rankings 1 or 2	Rankings 3 or 4	Grades 4-6 Rankings 1 or 2	Grades 4-6 Rankings 3 or 4	Grades 7-8 Rankings 1 or 2	Grades 7-8 Rankings 3 or 4
Routine[1]	No category	25.0	20.0	28.6	-[2]	-	-	-	-	-
	Management	0.0	0.0	0.0	-	0.0	-	0.0	-	0.0
	Structuring	2.3	2.6	1.6	0.0[3]	2.9	0.0	3.6	0.0	1.8
	Verdict	46.2	51.4	41.9	50.0	46.2	-	51.4	50.0	41.5
Cognitive-Memory	Scribe	-	-	-	-	-	-	-	-	-
	Recapitulation	53.0	58.1	44.7	40.0	53.7	33.3	59.3	50.0	44.4
	Clarification	45.4	48.6	42.6	33.3	46.3	40.0	49.0	30.0	43.8
	Factual	77.1	80.9	71.4	61.5	78.6	69.2	82.2	46.2	73.4
	Lower Cognitive $\bar{X}$ =	58.5	62.5	52.9	44.9	59.5	47.5	63.5	42.1	53.9
Convergent Thinking	Translation	50.0	50.0	-	50.0	-	50.0	-	-	-
	Association	60.0	62.2	54.7	31.6	63.4	30.8	65.8	33.3	57.4
	Explanation	63.9	65.5	60.8	47.4	64.5	57.1	65.8	20.0	61.8
	Conclusion	62.1	68.3	55.3	61.3	62.3	69.2	68.1	55.6	55.3
Evaluative Thinking	Unstructured	63.4	69.7	52.0	53.3	64.0	57.1	70.2	50.0	52.2
	Structured	55.1	58.1	52.4	25.0	56.7	100.0	57.5	14.3	55.8
	Qualification	44.4	50.0	40.0	0.0	50.0	-	50.0	0.0	50.0
Divergent Thinking	Elaboration	46.7	33.3	60.0	33.3	48.1	0.0	38.5	100.0	57.1
	Divergent Association	56.2	66.7	42.8	42.8	66.7	66.7	66.7	25.0	66.7
	Implication	57.6	65.2	49.6	51.9	65.0	63.8	66.7	42.7	62.5
	Synthesis	50.0	100.0	0.0	50.0	-	100.0	-	0.0	-
	Higher Cognitive $\bar{X}$ =	55.4	62.6	46.8	40.6	60.1	59.5	61.0	34.1	57.6
	Overall $\bar{X}$ =	56.1	62.6	48.2	41.5	59.9	56.7	61.6	35.9	56.7

1. Not added to lower cognitive or higher cognitive mean correspondence totals
2. [-] = no teacher questions asked
3. [0.0] = teacher questions asked but no corresponding student answers given

TABLE 7

Percent One-to-One Correspondence Between Teacher Questions and Student Answers Smith & Meux Categories

							Grades 4-6		Grades 7-8	
	Categories	Overall	Grades 4-6	Grades 7-8	Rankings 1 or 2	Rankings 3 or 4	Rankings 1 or 2	Rankings 3 or 4	Rankings 1 or 2	Rankings 3 or 4
	No category[1]	73.0	75.6	70.3	-[2]	-	-	-	-	-
	Directing and Managing	-	-	-	-	-	-	-	-	-
Lower Cognitive	Defining	70.8	65.2	84.2	50.0	72.1	50.0	65.9	50.0	87.5
	Describing	62.7	65.3	58.6	53.1	66.7	56.8	69.1	46.3	63.1
	Designating	66.0	68.2	62.7	33.3	68.9	33.3	71.1	33.3	65.6
	Stating	14.3	0.0	16.7	0.0[3]	33.3	-	0.0	0.0	50.0
	Reporting	66.0	61.6	71.9	42.3	71.0	42.8	65.3	41.7	78.8
	Lower Cognitive X̄ =	56.0	52.1	58.8	35.7	62.4	45.7	54.3	34.3	69.0
Higher Cognitive	Substituting	60.0	66.7	50.0	-	60.0	-	66.7	-	50.0
	Evaluating	46.4	46.2	46.7	40.6	53.0	40.4	52.2	41.0	54.5
	Opining	48.3	50.5	45.4	41.8	52.9	45.3	54.2	37.2	51.2
	Classifying	40.0	50.0	33.3	-	40.0	-	50.0	-	33.3
	Comparing/Contrasting	51.1	53.8	42.4	36.4	52.4	44.4	54.7	0.0	45.2
	Conditional Inferring	41.8	47.0	35.7	31.7	45.5	33.3	50.0	30.8	38.6
	Explaining	49.7	51.4	46.5	42.4	52.5	46.9	52.8	36.5	51.7
	Higher Cognitive X̄ =	48.2	52.2	42.8	38.6	50.9	42.1	54.4	29.1	46.4
	Overall X̄ =	51.4	52.2	49.5	37.2	55.7	43.7	54.3	31.7	55.8

1. Not added to lower cognitive or higher cognitive mean correspondence totals
2. [-] = no teacher questions asked
3. [0.0] = teacher questions asked but no corresponding student answers given

correspondence at lower cognitive levels, the difference between lower cognitive and higher cognitive correspondences obtained by the Bloom Taxonomy is approximately two times greater than that obtained by the Smith & Meux system and approximately five times greater than that obtained by the Aschner-Gallagher system.

TABLE 8

Percent Overall Question/Answer Correspondences

Cognitive System	Lower Cognitive	Higher Cognitive
Bloom	62.3	46.9
Smith & Meux	56.0	48.2
Aschner-Gallagher	58.5	55.4
	$\overline{X}$ = 58.9	$\overline{X}$ = 50.2

Another important difference between the three cognitive systems was their ability to classify teacher/student dialogue in general. Considering the total number of teacher questions asked, the Bloom Taxonomy failed to classify 18.3% of them, Smith & Meux 9.8%, and Aschner-Gallagher a mere 0.4% (see Appendix F). When the teacher/student dialogue which occurred within a sample episode was considered, the percentage of questions and answers classified as no category was 73.0% for Smith & Meux, 31.4% for Bloom, and 25.0% for Aschner-Gallagher.

Based on these findings, the most useful system in terms of coding the greatest amount of teacher/student dialogue appears to be the Aschner-Gallagher system in which all but 0.4% of the teacher questions were classified. An offsetting consideration, however, is that this instrument is not the most efficient to apply due to the very large number of categories and subcategories it employs. The lesser abilities of the other two systems to classify teacher questions can be attributed to a lower number of useful cognitive thinking categories (Bloom) and category descriptions which almost entirely exclude problem-solving and divergent thinking processes (Smith & Meux).

There also appears to be a direct connection between a system's classification ability and the size of the lower and higher cognitive correspondences it obtains. For example, the Bloom Taxonomy failed to classify the largest number of questions and answers and, in turn, had the largest discrepancy between lower and higher cognitive question/answer correspondences. Conversely, the Aschner-Gallagher system failed to classify the lowest number of questions and answers and also had the smallest discrepancy between lower and higher cognitive correspondences.

The fact that the greater correspondences occur at lower cognitive levels probably relates to the fact that teaching has traditionally emphasized lower cognitive question/answer strategies which resulted in greater practice at lower cognitive levels. It is interesting to note, however, that despite the emphasis in schools on recall of facts and selection of "right/wrong" answers, the correspondence between teacher questions and student answers at lower cognitive levels is not much better than 60%. This finding is certainly less than might be expected, especially when one considers that the number of question/answer correspondences obtained do not depend on the students' answers being "correct" but only that they involve levels of thought appropriate to the teacher questions. When the ratings used to determine how applicable a category within a coding system was to a particular question/answer are considered, lower and higher cognitive dialogue rated as 3 or 4 showed higher one-to-one question/answer correspondence than dialogue rated as 2 or 1. Table 9 indicates the percent of correspondence for high and low ratings for each coding system. It appears that teacher questions that were easily coded initiated answers that also were sufficiently precise to be readily coded. This is further illustrated in Table 10. Teacher questions and student answers that were readily coded were in one-to-one correspondence on the rating approximately 75 percent of the time. This suggests that teacher questions which rate high in category descriptiveness and in comprehensibility (clarity, specificity) elicit a greater degree of student answers that are comprehensible and describable than teacher questions which rate low. This higher obtained correspondence for the higher ratings appears to be a stable characteristics since it held true regardless of whether teacher questions were asked at lower cognitive or higher cognitive levels.

It should be noted that the fact that question and answer comprehensibility was rated along with the descriptive utility of the category confounded two sources of problems for raters. Nevertheless, this seemed justified since it had become apparent during the data coding process that the selection of appropriately descriptive cognitive categories was dependent on the clarity and specificity of the dialogue. The greater the dialogue clarity, the easier the selection of descriptive categories became or, likewise, the simpler it was to decide that no categories applied. Thus, when the correspondence between cognitive categories was ignored and the data looked at solely from the standpoint of question and answer ratings, the above finding became apparent--teacher questions rated as high in clarity

TABLE 9

Percentage of One-to-One Correspondence
Between Questions and Answers

	Cognitive System	Rating 1 or 2	Rating 3 or 4
Lower Cognitive	Bloom	37.0	71.4
	Aschner-Gallagher	44.9	59.5
	Smith & Meux	35.7	62.4
		$\overline{X}$ = 39.2	$\overline{X}$ = 64.4
Higher Cognitive	Bloom	38.4	54.6
	Aschner-Gallagher	40.6	60.1
	Smith & Meux	38.6	50.9
		$\overline{X}$ = 39.2	$\overline{X}$ = 55.2

TABLE 10

Percentage of One-to-One Rating Correspondence
Between Questions and Answers*

		Student Answers	
	Ratings	1 or 2	3 or 4
Teacher Questions	1 or 2	60.5	39.5
	3 or 4	24.7	75.3

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* Data obtained directly from the raw data and represents an average of the separate Bloom, Aschner-Gallagher, and Smith & Meux systems' results.

and category descriptiveness tended to elicit student responses which were similarly rated. Likewise, teacher questions rated as low in clarity and category descriptiveness tended to elicit similar student responses.

A surprising result was that across all cognitive classification systems, grade levels 4-6 showed higher one-to-one question/answer correspondences than grades 7-8. As reported in Table 11, the mean percent of correspondences relative to cognitive categories was approximately 7% higher in grades 4-6 than in grades 7-8 for lower cognitive categories and approximately 10% higher for the higher cognitive categories. This can be explained, in part, by the fact that teachers in grades 4-6 asked simpler, easier-to-answer questions at both lower and higher cognitive levels than did teachers in grades 7-8. Increases in the number of higher cognitive questions and answers which occurred in the upper grades did not, in turn, lead to greater question/answer correspondences. Rather, they appear to be related to lower one-to-one correspondence between teacher question category and student answer category.

In terms of the interactions between classification systems, grade levels, and category ratings, the results are generally supportive of the main findings: higher category correspondences for ratings of 3 or 4 than for ratings of 1 or 2 regardless of grade level, and higher overall correspondences for lower rather than upper grades. As reported in Table 12, for grades 4-6 the small differences in lower and higher cognitive correspondences between ratings of 1 or 2 and 3 or 4 when compared with the larger differences at grades 7-8, suggest that teachers' questions may be simpler for the lower grades, thereby making students' answers less dependent on question clarity or specificity. On the other hand, the lack of proximity of the

TABLE 11

Percent Question/Answer Correspondence

Cognitive System	Grades 4-6	Grades 7-8
Bloom	73.1	54.8
Aschner-Gallagher	62.5	52.9
Smith & Meux	52.1	58.8
$\bar{X}$ =	62.6	55.5
Bloom	48.2	45.2
Aschner-Gallagher	62.6	46.8
Smith & Meux	52.2	42.8
$\bar{X}$ =	54.3	44.9

TABLE 12

Percent Question/Answer Correspondences

		Grades 4-6		Grades 7-8	
	Cognitive System	Ratings 1 or 2	Ratings 3 or 4	Ratings 1 or 2	Ratings 3 or 4
Lower Cognitive	Bloom	59.0	77.9	25.0	65.5
	Aschner-Gallagher	47.5	63.5	42.1	53.9
	Smith & Meux	45.7	54.3	34.3	69.0
	$\bar{X}$ =	50.7	65.2	33.8	62.8
Higher Cognitive	Bloom	42.9	50.9	35.3	64.3
	Aschner-Gallagher	59.5	61.0	34.1	57.6
	Smith & Meux	42.1	54.4	29.1	46.4
	$\bar{X}$ =	48.2	55.4	32.8	56.1

lower and higher cognitive correspondences between ratings of 1 or 2 and 3 or 4 for grades 7-8 suggests that since teachers' questions may be difficult, clarity and specificity may be far more critical for obtaining appropriately corresponding student answers.

Another aspect of the data that provides insight into the interactions between the cognitive category system used, the applicability of the categories, and students' grade level is the similarity of data for question/ answer correspondences across grades, e.g., a mean percent correspondence of 65.2 and 62.8 for lower cognitive categories and 55.4 and 56.1 in higher cognitive categories in the high rating levels for grades 4-6 and 7-8 respectively. This suggests that students' abilities to respond appropriately to lower and higher cognitive questions does not increase greatly with increased grade level. Also, the uniformly higher percent correspondences at lower cognitive levels suggests that students' abilities to answer lower order questions at corresponding cognitive levels are superior to their abilities to do so with higher order questions. Teachers and students across grades 4 through 8 appear to be equally experienced* in handling discussions which focus on recall of facts and selection of simple "correct" answers. On the other hand, given the uniformly lower percent of question/answer correspondences at higher cognitive levels, teachers and students across grades 4 through 8 appear to be equally inexperienced in handling discussions which focus on judgment, speculation, interpretation, analysis, and creative problem solving.

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* The distinction between experienced and inexperienced is probably an argumentative one since a strong case could be made for the fact that question/answer correspondences are no greater than 65% at lower cognitive levels, despite high comprehensibility ratings and traditionally extensive practice with this type of dialogue. Thus, there is an indication of poorer than expected teacher/student performance. This point will be developed further in the conclusion section.

To estimate the effect of amount of teacher training on question/answer correspondences, data collected after five weeks of self-instruction (Gall, et al., 1970) was compared to data collected after two hours of expert instruction (Willson, 1973). The results showed slightly higher one-to-one question/answer correspondences for Gall's teachers at both lower cognitive and higher cognitive levels (see Table 13).

The comparison reported in Table 13 is complicated by the fact that in the analysis of the Gall, et al. data, 37.2% of the questions and answers occurring within the same episode could not be classified by the Bloom Taxonomy (i.e., they were coded as no category). In addition, these data

TABLE 13

Percent Question/Answer Correspondences

	Bloom categories	Willson (1973)* Grades 2, 5, 6	Gall, et al. (1970)** Grades 4, 5, 6
Lower Cognitive	Knowledge	64.4	73.1
	$\overline{X}$ =	64.4	73.1
Higher Cognitive	Comprehension	70.0	44.4
	Application	25.6	-
	Analysis	44.3	46.2
	Synthesis	31.4	56.9
	Evaluation	22.2	49.2
	$\overline{X}$ =	38.7	$\overline{X}$ = 49.2

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* Data calculated from raw data reported in Willson's study, p. 428.
** Data obtained from Table 5, column two.

showed that only one teacher question was asked in the application category, whereas Willson's data contained 129 teacher questions at this cognitive level. Despite these dissimilarities, it still appears appropriate to state that the more extensive teacher training in Gall's study resulted in an average increase of approximately 10% in question/answer correspondences at both lower cognitive and higher cognitive levels.

Summary of Results

The results of data analyses were reported in terms of the individual teacher question/student answer correspondence values obtained for the Bloom, Aschner-Gallagher, and Smith & Meux systems combined. The interpretation and discussion of the data, however, relied mainly on the average correspondence values because they were regarded as being the most stable estimates of the relationship between teacher questions and student answers, independent of the cognitive classification system used. In summary, the results obtained were:

- The average overall correspondence (all cognitive categories combined) between teacher questions and student answers was 53%--Bloom, 51%; Aschner-Gallagher, 56%; Smith & Meux, 51%. These figures are considered to represent the most reasonable estimate of the frequency with which Minicourse trained teachers receive student answers to their questions at the cognitive level they were striving to elicit.

- The average question-answer correspondence was slightly higher at lower cognitive discussion levels (59%) than at higher cognitive discussion levels (50%). This result was attributed to teachers' and students' having traditionally had greater experience in lower order (fact/recall) discussions.

- The average question-answer correspondence was slightly higher for elementary grades 4-6 (58%) than it was for junior high grades 7-8 (50%). This unexpected reversal in grade level performance was attributed to the fact that the elementary teachers tended to ask more "simple-minded" questions of their students than did the junior high teachers.

- The overall question-answer correspondence was considerably higher when teachers asked clear, specific questions (59%) than then they asked vague, generalized questions (39%). Also noted was the tendency for students' answers to pattern themselves after teachers' questions, i.e., becoming more vague and general (60% of the time) or more clear and specific (75% of the time) when the preceding teacher questions were either vague or specific. Although these results were somewhat confounded by the fact that the clarity ratings were also confounded with the applicability of the coding system's cognitive categories, this rating was judged, ultimately, to be more dependent on question-answer clarity than on the applicability of the category in the coding system.

- The overall question-answer correspondence was somewhat higher when teachers were trained for 5 weeks in higher cognitive questioning (54%) than when they were trained for only 2 hours (43%). This comparison is considered only tentative, however, since the two samples and analyses are not strictly equivalent, i.e., the 5 week sample used grades 4, 5 and 6 while the 2 hour sample used grades 2, 5 and 6; the 2 hour sample showed many responses that were coded in the application category while the 5 week sample did not; and the 5 week sample showed many no category responses, while the 2 hour sample did not.

- The question-answer correspondence results obtained by analyzing the data in terms of interactions between cognitive levels, grade levels, and the clarity of category-descriptiveness ratings were consistent with the results obtained when each of these variables was analyzed separately. The only new information gained through this analysis was that the range of correspondences between the high clarity versus low clarity dialogue was greater for grades 7-8 (33% to 62%) than for grades 4-6 (48% to 65%). This result was attributed to the greater dependence of students on teacher clarity and specificity as the latter's questions became more difficult.

- The question-answer correspondence results obtained separately for each of the three cognitive classification systems tended to differ when different divisions of the data were made. For example, the results for higher cognitive dialogue with low (1 or 2) clarity ratings was: Bloom, 38%; Aschner-Gallagher, 41%; Smith & Meux, 39%; this can be contrasted to the results for lower cognitive dialogue, grades 4-6, where: Bloom, 73%; Aschner-Gallagher, 62%, Smith & Meux, 52%. These differences were attributed mainly to the differing abilities of the three systems to classify teacher-student dialogue due to varying numbers of cognitive categories and varying degrees of descriptive appropriateness of these categories.

CONCLUSIONS AND RECOMMENDATIONS

It came as somewhat of a surprise to learn that when the differences between the three cognitive classification systems were averaged, the overall correspondence between teachers' questions and students' answers was 53%. This level of question-answer correspondence appears to be rather low, especially when one considers that the result was not dependent on students' answers being "good" nor even "correct," but merely that they utilize the appropriate cognitive processes required by teachers' questions. Furthermore, this value of 53% appears to be a relatively reliable estimate since the range of values obtained across several divisions of the data was quite narrow. The question-answer correspondences resulting from variations in the cognitive classification system used, the grade level of students, and the level of cognitive questioning all fell within the 50-60% range. Variations in the degree of questioning clarity and the length of teacher training accounted for question-answer correspondences both within and below this range.

It can be concluded, therefore, that despite five weeks of training in higher cognitive questioning, teachers can expect little better than half the questions answered by their students to use the cognitive processes that the question attempts to elicit. This situation certainly leaves a great deal of room for teachers to improve their students' higher cognitive discussion performance.

In attempting to account for the modest correspondence between teachers' questions and student' answers, four possibilities seem possible:

- The amount of time spent in training teachers may have been inadequate. It was shown that five weeks of teacher training in higher cognitive discussions yielded an average increase of 10% in question-answer correspondence over a mere two hours of training. This gain, however, was small relative to the time and effort necessary to achieve it. Thus, spending time in training up to or beyond five weeks does not seem to be a very efficient nor cost-effective approach to obtaining gains in question/answer correspondence.

- The methods of training teachers probably are not optimal. The self-instructional microtoeaching format may have prevented teachers from gaining valuable situation-specific information and feedback during training by reducing or eliminating contacts with fellow trainees and experts. Such feedback is requested frequently. Teachers seem to desire additional information in the form of opinions, directions, and advice from fellow trainees, experts, or knowledgeable coordinators. The fact that Willson's training involved an expert instructor who provided time for individualized feedback sessions may, to some degree then, explain why the average question-answer correspondence obtained with two hours of teacher training was only 10% less than the average correspondence obtained with five weeks of teacher training.

- The training of teachers in questioning behavior may have failed to eliminate poor questioning habits. In the course of analyzing the higher cognitive classroom discussions, it was noticed that teachers frequently exhibited various negative questioning behaviors such as repeating students' answers, answering one's own questions, allowing insufficient time for students to think, failing to probe for "better" or more thoughtful answers, and asking leading questions (playing guessing games). It is probable that eliminating these behaviors would have contributed to increasing teachers' questioning effectiveness which, in turn, might possibly have led to enhancing the degree of cognitive correspondence between teachers' questions and students' answers.

  It should be pointed out, however, that while previous studies have documented the degree to which teachers have manifested these many negative questioning behaviors (Borg, Kelley, Langer, & Gall, 1970; Morgan & Schreiber, 1969; Wright & Nuthall, 1970), no studies have as yet demonstrated the relationship between such behaviors and the performance of teachers and students in higher cognitive discussions.

- The teachers and students did not have a common frame of reference regarding higher cognitive discussions. It was shown from the post hoc analysis of Willson's data, that simply getting teachers to ask greater numbers of higher cognitive questions had little relationship to the degree of question-answer correspondence obtained. Thus, it seems that the relationship between the number of questions asked at each cognitive level and the number of corresponding student answers obtained at each level is not a particularly strong one. A possible explanation for this weak relationship is that students seem to be lacking a common frame of reference with their teachers regarding higher cognitive discussions. That is, students do not seem to have a basic understanding of their teachers' specific expectations regarding how and when to use various cognitive processes. This notion is based on the fact that during the data analysis it was seen that students frequently appeared to be confused over teachers' questions--regardless of their cognitive level--and so resorted to "silence," to saying "I dunno," or to guessing.

The argument could be raised here that students' performance in terms of giving appropriate answers will most likely improve with greater practice. This reasoning, however, can be countered by pointing out that the average lower cognitive question-answer correspondence for 7th and 8th graders (who can be considered to have had a great deal of experience in answering fact/memory type questions) was only 55%. Furthermore, the evidence suggests that as students' grade level and experience increases, teachers' questions get more difficult, thereby serving to reduce the correspondence between questions and answers. Thus, it was found that the average lower cognitive (fact/memory) question-answer correspondence obtained for 7-8th grade classes (55%) was below that obtained for 4-6th grade classes (63%).

It seems reasonable to suppose, therefore, that students' abilities to formulate appropriate higher (and lower) cognitive answers may be dependent on their being taught the rules of the higher cognitive questioning "game." One way this could be accomplished would be to train teachers to adopt a teaching strategy for developing a frame of reference with their students. Such a strategy might involve having teachers clearly define the goals of the discussion, the types of thought processes which would be employed, and the various verbal cues which would be used to tip students off when to employ the thought processes. This approach would involve training students in the same (or similar) higher cognitive discussion methods which the teachers had learned. It is believed that this teacher-training/student-training approach offers the two-fold advantage of (1) providing mutual reinforcement for teachers and students to engage in higher cognitive dialogues, and (2) reducing drastically the length of time it takes students to catch on to the higher cognitive discussion "game."

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APPENDIX A

Posttape Stimulus Articles

Posttape Topic
Grades 4-6

GRIZZLY

California's state animal--the grizzly bear--has not been seen in our state since 1922. All over the western part of the United States the grizzly has been hunted and killed. The species may become extinct. Some men think that this "King of the Wilderness" is the most dangerous of all game animals.

Before the exploration and settlement of the West, thousands of grizzlies lived in the mountains and plains. Now only about 750 grizzlies live within our Western states, especially Washington, Colorado, Wyoming, Idaho, and Montana. About 10,000 survive in Alaska, and many thousands more in Canada.

The grizzly wears a loose-fitting fur coat. He weighs from 400 to 600 pounds, but has been known to weigh as much as 1,000 pounds. His shoulders are humped and the hair on his back and sides is tipped with silver, giving him a frosty appearance. His tail is very short. His legs are short, too, but very powerful. He walks flat on the soles of his feet, which have long, heavy claws. Though his body is heavy and his legs are short, the grizzly can run rapidly for a short distance. He can outrun a horse in the first one hundred yards. He attacks men only when he has been cornered.

The grizzly eats both vegetable matter and animal flesh. He likes grass and roots, fruits, berries, insects, honey, and fish. He also eats small rodents. He hunts and eats sheep and cattle.

Grizzlies don't reproduce in great numbers. Females do not mate until they are three or four years old. They mate only every other year and they normally give birth to only two cubs. Much killing has been done not only by game hunters but also by sheep ranchers and cattlemen who shot the grizzly to protect their livestock. Thus grizzly bears are in danger of becoming extinct.

The government of Alberta, Canada once thought it was necessary to protect people from grizzlies; now it feels that grizzlies are the ones to be protected--from people. The government has set aside an area of 8,000 square miles of land in northern Alberta which is to be a game reserve for these mighty "Kings of the Wilderness."

Grizzlies are a part of our wilderness and, as such, deserve protection. The pioneer days, when we fought to overcome nature, are long gone. We now have the leisure to help preserve its wonders for the future. There is a steady increase of interest in wildlife by young people and groups such as the Boy Scouts Girl Scouts, and Campfire Girls. Everyone, young and old, can enjoy the wildlife about him and do something to help preserve it. Perhaps in time everyone will follow the belief held by Alan Devoe that "we are brothers of all living things."

Adapted from Wildlife in Danger by
Ivah Green.

Posttape Topic
Grades 7-8

THE LOSING BATTLE FOR AIR FIT TO BREATHE

America's air is becoming more and more contaminated. Yet, activity across the nation to deal with smog appears to be lagging further and further behind actual needs. This is acknowledged by qualified Federal and state officials.

On the eve of Clean Air Week, officials summed up the situation this way: "There has been a lot of progress in the last couple of years. But the overall picture is that so many localities haven't really come to grips with the air pollution problem that people might be appalled if they knew how their welfare was being trifled with."

More than 140 million tons of contaminates are being hurled into the atmosphere every year, by Federal estimates. Two years ago it was only 130 million tons. The increase has been caused by many things--more people, more automobiles, more industry, more space heating.

It is becoming widely recognized that air pollution has adverse effects on health. It also decreases property values. In damage to crops and other plants, its cost is reckoned in millions of dollars.

States and localities generally still have penalties for air pollution that are little more than a wrist-slap (the fine is as low as $10). Enforcement is generally sketchy and weak. Few states have provided for regular inspection of smog-control equipment on cars. The total amount of money budgeted this year by all state, regional and local air pollution control agencies is less than 25¢ for each person in the country. By contrast, we spent $15 a year per person to deal with the relatively simple problem of garbage.

What is the outlook for cleaner air? Some observers, particularly scientists, are pessimistic that the nation will begin to meet the problem of air pollution too late. One observer said, "We are a crisis-oriented society. We react only to emergencies. And we can't wait until every city in the country has had an emergency like New York's and Los Angeles's sieges of smog."

Air pollution experts, with a shorter range focus on development, seem more optimistic. They note that there are now approximately 200 state, regional, and local air pollution agencies. Ten years ago there were almost none. Some air pollution experts say that progress depends mostly on how much pressure the public will bring on politicians and administrators. One official observed, "Solving air pollution is a lot more complicated than putting a man on the moon, but there is one vital factor in both undertakings: a majority of people have to determine that the job is worth doing, and that it shall be done."

Adapted from The San Francisco Chronicle,
October 26, 1969.

APPENDIX B

Cognitive Classification Systems:

Bloom Taxonomy

Aschner-Gallagher System

Smith and Meux System

BLOOM TAXONOMY (MODIFIED)

FLORIDA TAXONOMY OF COGNITIVE BEHAVIOR

TOT							
T	P	T/ P	T/ P	T/ P	T/ P	T/ P	1.10 KNOWLEDGE OF SPECIFICS
							1. Reads
							2. Spells
							3. Identifies something by name
							4. Defines meaning of term
							5. Gives a specific fact
							6. Tells about an event
							1.20 KNOWLEDGE OF WAYS AND MEANS OF DEALING WITH SPECIFICS
							7. Recognizes symbol
							8. Cites rule
							9. Gives chronological sequence
							10. Gives steps of process, describes method
							11. Cites trend
							12. Names classification system or standard
							13. Names what fits given system or standard
							1.30 KNOWLEDGE OF UNIVERSALS AND ABSTRACTIONS
							14. States generalized concept or idea
							15. States a principle, law, theory
							16. Tells about orgnztn or structure
							17. Recalls name of prin, law, theory
							2.00 TRANSLATION
							18. Restates in own words or briefer terms
							19. Gives cncrt exmpl of an abstract idea
							20. Verbalizes from a graphic rprsntatn
							21. Trans vrblztn into graphic form
							22. Trans fig stmnts to lit stmnts, or vice v
							23. Trans for lang to Eng, or vice versa

FLORIDA TAXONOMY OF COGNITIVE BEHAVIOR

TOT							
I	P	T/ P	T/ P	T/ P	T/ P	T/ P	3.00 INTERPRETATION
							24. Gives reason (tells why)
							25. Shows similarities, diffrncs
							26. Summarizes or concludes frm obs of evdnce
							27. Shows cause and effect rltnshp
							28. Gives analogy, simile, metaphor
							29. Performs a directed task or process
							4.00 APPLICATION
							30. Applies previous learning to new sitn
							31. Applies principle to new situation
							32. Apply abstrct knldg in a prctcl sitn
							33. Idntifs, selects, and carries out process
							5.00 ANALYSIS
							34. Distngshs fact from opinion
							35. Distngshs fact from hypothesis
							36. Distngshs cnclsn frm stmnts wch suppt it
							37. Points out unstated assumption
							38. Shows interaction or relation of elements
							39. Points out prticlrs to jstfy cnclsn
							40. Checks hypthss with given info
							41. Dstngshs rel frm irrelvnt stmnts
							42. Detects error in thinking
							43. Infers prpse, pt of view, thghts, feelings
							44. Recog bias or propaganda
							6.00 SYNTHESIS (Creativity)
							45. Reorganizes ideas, materials, process
							46. Produces unique cmmnctn, divergent idea
							47. Produces a plan, prpsd set of oprtns
							48. Designs an apparatus
							49. Designs a structure
							50. Devises scheme for classifying info
							51. Formulates hypothesis, intelligent guess
							52. Mks dedctns frm abstrct smbls, propostns
							53. Draws inductive generalizatn frm specifcs
							7.00 EVALUATION
							54. Evaluates somthing from evdnce
							55. Evaluated somthing from criteria

ASCHNER-GALLAGHER SYSTEM

TABLE OF CATEGORIES
WITH SHORT DEFINITIONS

I. ROUTINE (R)

This category includes routine classroom procedural matters such as management of the classroom, the structuring of class discussion and approval or disapproval of the idea or the person

Page

MANAGEMENT 1

Mq - Question: Requests or invitations to speak; calling for questions, as in "Anybody have a question?" 1

Mp - Procedure: Announcements or procedural instructions, given or requested for individuals or the group as a whole 2

Ma - Aside: Incidental or parenthetical comment; gratuitous content . . 2

Mnc - Nose-Counting: Calling for or responding with a show of hands for a tally or canvas 3

Mfb - Feedback: Request for or response with signs from group as to whether or not the speaker's actions or remarks are clearly understood 3

Mw - Work: Non-verbal actions or seatwork going on in connection with current discussion or class proceedings 3

X - Unclassifiable response primarily due to technical recording difficulties . . . .

STRUCTURING 4

Sts - Self-Structuring: Conventional prefatory move to signal content and purport of one's own next remarks or behavior. 4

Sto - Structuring Other(s): Engineering next speech or actions of other(s). Monitoring other's performance. Pump-priming to keep discussion going on a point already before the class . . . 5

Stf - Future Structuring: Forecast of future activity, study, learning, etc. beyond this particular class session. 6

Stc - Class Structuring: Focusing class attention on point to be emphasized or taken up; laying groundwork for question or problem; probing, pushing, adding data for bogged-down class (teacher only) 6

VERDICT. 7

Ver Verdict: (+ or -) Impersonal praise or reproach on quality of *academic* performance of individual or group 7

Verp - Personal Verdict: (+ or -) Personal praise or reproach of individual. (Occasionally by T on whole class) Negative Verp generally on deportment. 8

Agr - AGREEMENT: (+ or -) Acceptance or rejection of content; conceding a point; *not* permission-giving nor procedural 9

S - SELF REFERENCE: Speaker's personal report or comment upon or about self. Often conventional device; cautionary tactic . . . 10

Du - DUNNO: Explicit indication that one does not know 10

Mu - MUDDLED: Speaker confused, mixed up, flustered 11

Hu - HUMOR: Remark of evident witty, humorous, or comic intent; response (usually laughter) to same 11

II. COGNITIVE-MEMORY (C-M)

C-M operations represent the simple reproduction of facts, formulas and other items of remembered content through use of such processes as recognition, rote memory and selective recall.

Scr - SCRIBE: Giving a spoken or written spelling or exemplification of a word or expression 13

RECAPITULATION 13

Req - Quoting: Rote recitation or literal reading from text, paper or notes in hand 14

Rep - Repetition: Literal or nearly verbatim restatement of something just said 14

Rec - Recounting: Narration of past extra-class occurrence 14

Rev - Review: Recitation of material which occurred or was discussed in current or past class session 15

CLARIFICATION 16

Clm - Clarifying Meaning: Rendering a previous statement more intelligible either by (a) restating or rephrasing or (b) adding informative details. 16

Clq - Clarifying Qualification: Render a previous statement more accurate either by (a) "Entering a rider" upon the remark or (b) entering an explicit correction 17

FACTUAL 18

Fs - Fact Stating: Requests for and recitations of items taken to be matters of fact 18

Fd - Fact Detailing: Spinning out further a prior assertion of fact or other statement (As, Exr) in which factual items were mentioned 19

Fm - Factual Monologue: Reporting of factual material in the form of a monologue during which verbal exchange is conventionally excluded 20

III. CONVERGENT THINKING

Convergent thinking is thought operation involving the analysis and integration of given or remembered data. It leads to one expected result because of the tightly structured framework which limits it.

TRANSLATION 22

Tr - Translation: Shift of conceptual material from symbolic or figural content to semantic, or vice versa 23

ASSOCIATION 23

As - Association: Involving likenesses and differences; degrees of comparison; and relationships of direction, spatial position and/or classification, etc. 23

EXPLANATION 24

Exr - Rational Explanation: Asking or telling why X is the case; why Y caused X, etc. Substantiating a claim or conclusion by citing evidence 24

Exv - Value Explanation: Asking or telling why X is good, bad, useful, important, etc. Justifying a rating, viewpoint, or value-based judgment by giving reasons why 25

Exn - Narrative Explanation: Step-by-step account of how something is done, how a mechanism works, or of what led up to an event or given outcome 26

CONCLUSION 26

Gen - Generalization: Integration of prior remarks by slightly more general reformulation 26

Cons - Summary Conclusion: Summary reformulation, often serial or enumerative, of material treated in discussion or reading 27

Conl - Logical Conclusion: Calling for a deductively drawn implication from material presented 28

IV. EVALUATIVE THINKING (ET)

Evaluative thinking deals with matters of value rather than matters of fact and is characterized by verbal performance by its judgmental character.

UNSTRUCTURED 31

Ura - Unstructured Rating: A value judgment produced or requested on some idea or item in terms of a scale of values provided by the respondent. 31

Uju - Unstructured Judgment: A value judgment produced or requested on some idea or item wherein the value dimension has already been provided 32

STRUCTURED 32

Svp - Structured Probability: An estimate or speculative opinion is given or requested as to the likelihood of some occurrence or situation 32

Svc - Structured Choice: Speaker calls for or declares his position as a choice between alternatives (not between Yes or No answers) . . 33

QUALIFICATION 33

Qj - Qualified Judgment: An offer or request for a rider or modification to a prior value judgment. Also, attempts to make more precise the value dimension discussed 33

Q-c - Counter Judgment: Speaker declares a directly opposed position with respect to value statement of a previous classroom speaker. . 34

V. DIVERGENT THINKING (DT)

In a Divergent Thinking sequence, individuals are free to independently generate their own data within a data-poor situation, often taking a new direction or perspective.

El - Elaboration: Structured or free (s or f). Building upon a point already made; filling out or developing a point, but not shifting to a new point, often by concocting instances or examples 37

Ad - Divergent Association: (s or f) Constructing a relationship between ideas, casting the central idea into sharper and often unexpected perspective, by comparisons, analogies, etc. 38

Imp - Implication: (s or f) Extrapolation beyond the given, projection from given data--typically by antecedent--consequent or hypothetical construction--to new point(s) of possibility 39

Syn - Synthesis: Spontaneous performance, tying in, integrating the current central idea with an entirely new point or frame of reference. May be a variation or reversal of a previous conclusion 40

Double-paired Ratings: The complex nature of verbal classroom interaction often requires the combination of more than one of the above described categories. Samples of the more common combinations are given in the appendix.

x - Aschner - Gallagher System

April, 1962 Version

ORGANIZATION OF CATEGORY SYSTEM

I. R ROUTINE		II. CM COGNITIVE MEMORY		III. CT CONVERGENT THINKING		IV. ET EVALUATIVE THINKING		V. DT DIVERGENT THINKING	
M	Mq	Scr		Tr		U	Ura	El	s/f
	Mp						Uju		
	Ma	Re	Req	As				Ad	s/f
	Mnc		Rep			S	Svp		
	Mfb		Rec	Ex	Exr		Svc	Imp	s/f
	Mw		Rev		Exv				
					Exn	Q	QJ	Syn	
St	Sts	Cl	Clm				Q-c		
	Sto		Clq	Con	Gen				
	Stf				Cons				
	Stc	F	Fs		Conl				
			Fd						
Ver	+1-		Fm						
Verp	+1-								
Agr	+1-								
S									
Du									
Mu									
Hu									

3. Kinds of Entries

The foregoing discussion is perhaps sufficient to indicate the way in which we arrived at a set of logical categories. The categories into which the entries were grouped are as follows:

1) Defining. Entries making up this group are concerned with how words or other symbols are used to refer to objects (abstract or concrete). These entries vary in form and content, but in general they ask implicitly or explicitly for the meaning of terms.

In some cases, a term is given and a definition or meaning of the term is to be supplied as a response to the entry. In the example, 'What does the word "dorsal" mean?', the question requires that whatever is designated by "dorsal" be indicated.

In other cases, neither the word 'mean' nor 'define' occurs in the entry. Rather the entry asks what the something is, for example, 'What is a cablegram?'. These entries require that the noun appearing in the question be defined, or that the referent of the noun be described.

In a few cases, the noun in the entry is a grammatically proper name. In these cases, the entry requires that the object designated by the proper name be described or otherwise indicated. For example, 'Who was Paul Elmer More?' is a question which asks that the person referred to be described unambiguously.

Finally, some entries ask for a term or expression that can be substituted for another term or expression; for example, 'What is the symbol for gravity?'.

2) Describing. To describe is to represent something by words or drawing, to tell about something. Thus, the entries making up this category mention or suggest something and require that an account of this something be given. In the question 'What can you tell us about the gill rakers?' we are asked to describe the gill rakers.

However, not all questions which mention or allude to something ask for a description. For example, 'What would be some examples of a sense organ?' is a question which names a class of things and asks that instances of it be cited. No description is called for.

In some cases, as in the example just given, it is easy to tell whether the entry requires a description or an identification. But in a large number of entries the intent of the entry in this regard is obscure. 'What did Cleveland find out?' is a question which might be answered by naming whatever it was that Cleveland uncovered. But our expectations would be more nearly satisfied were the question answered by a brief account of what he found out. On the other hand, 'What is a common defect of this part (cerebellum) of the brain?' can plainly be answered by naming the defect. But a description of the defect would not be inappropriate as an answer.

3) Designating. To designate is to identify something by name -- word or other symbol. The name designates the object (abstract or concrete) to which it refers. Thus, this group of entries is made up of items in which something is described or otherwise indicated, and the name used to refer to it or to identify it is asked for. These entries vary widely in form and content. In general, they demand that objects (abstract or concrete) be designated by name or other symbol, or simply by pointing. Consider the question 'What do you call a word used to modify a verb?'. The question is answered by giving the name of the word, namely, 'adverb'. The question 'What reptile did he show in the film?' is answered in the same way, although the question does not explicitly ask what the reptile is called. Again, 'What is the word (in a given sentence) that's to be modified?' is a question which can be answered by pointing to the particular word or by saying it.

4) Stating. Entries in this group do not ask for names, descriptions, etc., but for statements of issues, steps in proofs, rules, obligations, theorems, conclusions, ideas, beliefs, promises, threats, etc. For example, the question 'What is the conclusion?' asks for a statement of some sort. It can seldom be answered satisfactorily merely by naming.

5) Reporting. The entries in this group ask for a report on what a book or document

says, for information in the text, or for a summary or review, and the like.

6) *Substituting*. The entries making up this category ask the student to perform a symbolic operation usually of a mathematical nature.

7) *Evaluating*. To engage in evaluating is to estimate the worth, dependability, etc. of something. An entry of this type requires that some object, expression, event, action, or state of affairs be rated as to its value, dependability, desirability, and the like. For example, the question 'Is he a good judge?' asks the student to rate a judge who acts in some particular manner.

8) *Opining*. In opining, the body of evidence from which the conclusion is drawn is not explicitly delineated by the entry of the episode, i.e., no explicit conditions are given on which the conclusion is to be based. The person may be required to supply that which is the case, or to affirm or deny what is suggested in the entry as being the case. It is characteristic of such episodes that the conclusion involves an inference from evidence rather than a report of a single fact. 'Do you think that historians will say that Wilson was right in proposing the League of Nations?' is an entry which asks for a conjecture about how historians of the future will judge Woodrow Wilson with respect to a particular set of actions -- those involved in proposing the League of Nations.

9) *Classifying*. Each entry in this group makes explicit reference to an instance or class (type, sort, group, set, kind) of things or both. The entry requires that a given instance be put in the class to which it belongs, or that a given class be placed in a larger class to which it belongs as a subclass. For example, 'What special type of triangle did you find it to be? ' is a question which makes reference by the 'it' to a particular triangle. The student is expected to tell what class of triangles this particular one belongs to. As an illustration of questions which ask that a class be placed in a larger class, consider the following: 'What group of animals does the jellyfish belong to?'. In this question the term 'jellyfish' does not refer to a particular jellyfish but to a subclass. The student is required to name the larger class to which the group of animals called 'jellyfish' belongs.

10) Comparing and Contrasting. This type of entry requires that two or more things -- actions, factors, objects, processes, etc. -- be compared. In some cases, the entry specifies two or more things, and asks that either their similarities or differences be noted. In other cases, the entry asks that they be compared with respect to a particular characteristic. The question 'What's the difference between probation and parole?' illustrates the first of these cases. The student is asked merely to make a comparison, the points of comparison not being explicitly indicated. The second case is illustrated by the question 'Is his (fish's) eye very large compared to the size of the grasshopper's?'. Here the eyes of the two different animals are to be compared with respect to size only.

In still other cases, the entry names a thing and requires that another thing similar to it, be indicated. Consider the question 'Which one (Canadian house) corresponds to the House of Commons?'. The House of Commons is the given object. The question asks that the Canadian house most like it be named. Entries of this kind do not require that differences or similarities be explicitly stated. The student considers the differences or likenesses and selects the object in terms of them, as required by the entry.

11) Conditional Inferring. These entries contain an antecedent, that is, the conditional part of a statement. In the sentence 'When it rains, the streets are wet' the phrase 'when it rains' is the antecedent. The phrase 'the streets are wet' is the consequent. Now, the entries which make up this category give an antecedent. Sometimes they give both an antecedent and a consequent. But they never contain a consequent alone.

Here is an example of an entry containing an antecedent only: 'How does that (undemocratic handling of colonies) affect the mother country?'. The phrase 'undemocratic handling of colonies' is the antecedent. It describes the condition of which the effect on the mother country is the consequent. The question asks the student to tell what the consequent is. Take another case: 'If that diagonal (in rhombus) is given as 12 and this angle is 60, what is the angle at C and at A?'. The antecedent is ' if that diagonal (in rhombus) is given as 12 and this angle is 60'. The consequent asked for by the question is the size of the angle at C and A. In all cases where the antecedent alone is given, the entry requires that the consequent -- effect, result, outcome, subsequent behavior, etc., -- be supplied as the answer.

Consider an example of an entry containing both an antecedent and a consequent: 'Did you ever get a headache from sleeping in a draft?'. The phrase 'sleeping in a draft' is the antecedent, and 'get a headache' is the consequent. Now, in entries of this sort, the student is required to affirm the consequent, to deny it, or to say he does not know whether he has ever suffered or enjoyed the consequent under the given condition or not.

12) Explaining. There are several types of explanatory entries, but they all have one thing in common. They give a particular consequent and they require that an antecedent be supplied. To explain is to set forth an antecedent condition of which the particular event or process to be explained is taken as the effect, or else, to give the rules, definitions, or facts which are used to justify decisions, judgments, actions, etc. In the example 'Why did the light go out?', the consequent is 'the light go out.' The question asks the student to give a reason (reasons) to account for the fact that the light is out. The reason(s) is the antecedent.

There are six kinds of explanation entries depending upon the sort of antecedent used to account for the consequent. They are mechanical, causal, sequent, procedural, teleological and normative. These are described as follows:

12.1) Mechanical Explaining. This type of entry gives an event or action which is to be accounted for by describing the way the parts of a structure fit or work together. A sample entry will help to make this category clear: 'How (do fish make a sound)?'. The action to be accounted for is 'fish make a sound.' Now, the antecedent consists of some kind of structure which enables the fish to make vibrations. A description of this mechanism would constitute an answer to the entry.

12.2) Causal Explaining. Entries of this type give events situations, or states to be accounted for and ask that a state of affairs be cited of which the given event (or situation or state) is taken to be the result. Consider the example: 'What makes a person's muscles sort of twitch-like?'. The event to be explained is the twitching of a person's muscles. The explanation consists of a description of the condition of the nerves associated with the twitching.

12.3) Sequent Explaining. Entries of this sort ask how something happened. They require that a sequence of events be cited of which the event to be accounted for is the sequel. For example the question 'How did McKinley happen to be killed?' requires the recitation of the events leading up to the assassination of President McKinley.

12.4) Procedural Explaining. These entries require that the steps or operations by which a given result or end is attained be described. Here is a sample entry: 'How did you get 72 (for an answer)?'. It is expected that the student tell the steps he took to obtain this answer.

12.5) Teleological Explaining. This type of entry contains descriptions of actions, decisions, states of affairs, or the worth of things. It requires that these be accounted for or justified by reference to purposes, functions, or goals. An entry of this sort is: 'Why are you doing those problems?'. The consequent to be explained is 'doing those problems.' The explanation consists in giving a purpose, say, to satisfy an assignment.

12.6) Normative Explaining. Entries of this type do either of two things. First, they may mention or assume a decision, judgment, or state of knowing and require that it be justified by citing a definition or characteristic or both. Here is an example: 'Why do we call them (animals between vertebrates and invertebrates) the Chordata animal group?'. The consequent is the underscored part of the question. To give the antecedent in this case is to cite a definition of the chordata phylum and to point out that the animals in question have the characteristics called for by the definition.

Second, members of this group of entries cite actions, decisions, or choices (either made or to be made) and require that rules be given as reasons for the decisions, choices, etc. Consider this example: 'Why do we use shorter (in comparing two pencils as to length)?'. The consequent to be explained is 'we use shorter.' The antecedent demanded by the question consists of a rule prescribing the use of 'shorter' in such cases. Entries of this type usually call for grammatical or mathematical rules.

13) DirectING and Managing Classroom Many entries have little or no logical significance They are designed, not to evoke thought, but to keep the classroom activities moving along Such entries belong in this category.

APPENDIX C

Sample of Coded Transcript

Following is a sample of two pages of coded transcript using the Aschner-Gallagher System. Each completed teacher-student verbal interaction is lined off as a separate episode. The dialogue within each episode is coded with the cognitive category (abbreviated letters) and the rating scale value (numbers) which are deemed most appropriate by the coder.

Dialogue which is lined over is composed of extraneous comments or teacher questions which are ignored by the students.

Ex-3 T: Why do you suppose they feel this way, and why would they say something like this?

EX-4 S: Because it's strong and it can go in any kind of weather usually.

~~T: It's strong. What other reasons might there be?~~

Ex-4 S: It's feared by, you know, most people.

F-1 T: Are you afraid of bears?

F-1 S: No.

~~T: Is there anybody here who's afraid of bears?~~

~~S: Laughter.~~

Ex-3 T: I think we have to respect all the animals. We know they're dangerous. What other reasons might he be called "The King of the Wilderness"? Okay, we said, because they're strong and because they're feared. What else?

Ex-3 S: Because animals fear them too.

~~T: Animals fear them too.~~

Ex-3 Ad-1 S: The bear is mostly hunted almost in Alaska. So they should be "King of the Wilderness" because if they're the mostly hunted, then they're the mostly wanted . . .

As-3 V-1 T: Can any of you think of any other animal that might be a better or do you think the bear is probably the best?

As-3 S: A lion?

~~T: A lion might be the "King of the Jungle," we know~~ . . .

As-2 S: Buffalo.

~~T: The buffalo might be the king.~~

As-2 S: Leopard.

Ex-4 T: The leopard. Where were we? Why did you mention lion?

Ex-4 S: Well, because you know it might be strong and the same things, too.

Ex-4 T: Why did you mention buffalo?

~~S: Inaudible.~~

~~T: Okay, why then--yes?~~

Ex-4 S: Because they look the most fierce, and they'll kill you because they're kind of, well, because they've got mostly claws and their teeth are real big and everything and they look like they're going to kill you.

Ver-4 T: This is a good reason. I think this is why bears, right, are king. This is good.

Cl-4 S: That's not true. It said they can kill you, but they won't kill you. They just like horses, they just like cows and bulls. You can walk right in front of them and they won't attack you--not unless you scare them or wave a real brightly colored cloth, because the bright colors hurt their eyes.

Re-3 T: Oh. Bears are sensitive to colors? And they can see quite well?

F-4 S: Buffalos are.

~~T: Buffalos are.~~

F-4 S: And bulls.

~~T: And bulls. You know I read something in which it told me that bulls are color blind. That they can't tell the difference between red, blue.~~

Cl-4 S: They are because certain colors hurt their eyes.

NC S: Yeah, the sun shines on them.

As-3 F-3 T: Maybe the quick movements. This is interesting. Let me ask another question. Compare how it was before and after exploration and settlement of the West. What changes do you think took place with grizzly bear in this area? How was it before, and how do you think it was after? What was it like before? Tim?

As-3 S: There used to be a lot and now there's not too many.

~~T: There used to be a lot of bears. What do you suppose--what else? Yes?~~

F-3 S: Like they used to hunt them more with--instead of guns, sometimes they'd go out there with horses, they used to go with about six men and horses. And they'd go at the bear and they'd lasso him and stretch him apart and they'd

APPENDIX D

Mock Teacher Questions

MOCK TEACHER QUESTIONS
(for coder training)

1. T - What is a samovar?

   S - An urn used for heating water.

2. T - When did the Russians launch the first satellite?

   S - In October, 1957.

3. T - What happened to people in Athens who did not pay their debts?

   S - They were put in prison.

4. T - If communism were non-existent would the United States live in an untroubled world community?

   S - No.

5. T - What is the main point of this political cartoon? (Teacher shows cartoon drawing to student)

   S - Ignorance.

6. T - Do the United States and West Germany have the same or different attitudes toward the question of inflation?

   S - Different attitudes.

7. T - Why?

   S - Because their economies are not exactly alike and businessmen would feel differently about it in each country.

8. T - Look at the graph, Cindy, can you tell me what has happened to federal spending since 1945?

   S - It has increased.

9. T - How much?

   S - Almost 35%.

10. T - Why do you think it has increased?

    S - Because we have spent a lot of money on the war.

11. T - Why has France voiced opposition to American military bases in their country?

S - Because France is experiencing a rising nationalism attitude.

12. T - Okay; Can you think of any other reasons Mike?

S - No.

13. T - What will happen if air pollution gets very bad?

S - Everyone will have to wear gas masks and it could kill some animals.

14. T - If some animals are killed, what can happen to the balance of nature?

S - It will be upset.

15. T - Why?

S - Because we need animals for food.

S - But what if we developed synthetic food, then we wouldn't need animals.

16. T - Our class has been given an extra room to use for this month. What do you think we should use it for?

S - Let s use it for small group discussions.

17. T - Do you think the United States should have stricter laws and fines regarding litter?

S - Yes.

18. T - Why?

S - Because if they did people wouldn't litter as much.

S - Not necessarily, because the fine is large now and people still litter.

S - I think companies who litter should have to suspend operation for a mont

19. T - Is that a good idea, Brian?

S - No, because then some people who work there wouldn't have jobs.

20. T - John, how would you get people to stop littering?

S - Tell them not to do it.

21. T - What caused the ice on the sidewalk to melt today?

S - The temperature got up above 32° today.

22. T - What has that to do with the ice melting?

S - Ice always melts when the temperature is above 32°.

23. T - Are you sure it was that warm today?

S - Yes, I looked at the thermometer this morning and it read 35°.

S - Besides the only other thing that could have melted the ice was if somebody put salt on it and I know there wasn't any salt put on it.

24. T - Why do you suppose it got so warm today?

S - A warm wind came in from the South.

25. T - John, please state Einstein's formula for his theory of relativity and tell me what the symbols stand for.

S - $E=MC^2$; I forget what it means.

26. T - Do the benefits of technology outweight the shortcomings?

S - Yes.

27. T - Can you explain why?

S - Well, science helps man live longer and they can eventually solve the problems that go with technology.

28. T - Assuming that earth has been visited by beings from outer space, what purpose could they have in coming and why haven't they contacted us? Jeff?

S - They might want to see how we solve our problems and just want to observe us.

APPENDIX E

Coder Reliability Data

Coder Reliability Data

Bloom Taxonomy

Transcript Number	Coder pair comparisons		
	Gary - Mike	Gary - Sharon	Mike - Sharon
3	$\frac{129}{\frac{145+147}{2}} = \frac{129}{146} = .88$	-	-
9	-	$\frac{152}{\frac{196+202}{2}} = \frac{152}{196} = .78$	-
11	- - -	- - -	$\frac{112}{\frac{151+158}{2}} = \frac{112}{154} = .73$
13	- - -	- - -	$\frac{122}{\frac{136+145}{2}} = \frac{122}{140} = .87$
23	- - -	- - -	$\frac{138}{\frac{154+156}{2}} = \frac{138}{155} = .89$
30	- - -	$\frac{164}{\frac{197+203}{2}} = \frac{164}{200} = .82$	- - -
36	$\frac{152}{\frac{222+208}{2}} = \frac{152}{215} = .71$	- - -	- - -
39	- - -	$\frac{127}{\frac{138+136}{2}} = \frac{127}{137} = .93$	- - -
46	$\frac{193}{\frac{225+214}{2}} = \frac{193}{219} = .88$	- - -	- - -
63	$\frac{141}{\frac{159+148}{2}} = \frac{141}{153} = .92$	- - -	- - -
66	- - -	- - -	$\frac{108}{\frac{120+120}{2}} = \frac{108}{120} = .90$
74	- - -	$\frac{124}{\frac{128+132}{2}} = \frac{124}{130} = .95$	- - -
	$\bar{X} = .85$	$\bar{X} = .87$	$\bar{X} = .85$

Coder Reliability Data

Aschner-Gallagher System

Transcript Number	Coder pair comparisons		
	David - Audrey	David - Carol	Audrey - Carol
9	- - -	- - -	$\frac{187}{\frac{192+197}{2}} = \frac{187}{194} = .96$*
20	$\frac{157}{\frac{174+174}{2}} = \frac{157}{174} = .90$	- - -	- - -
36	- - -	$\frac{172}{\frac{209+209}{2}} = \frac{172}{209} = .82$	
42	- - -	- - -	$\frac{116}{\frac{138+139}{2}} = \frac{116}{138} = .84$
47	$\frac{100}{\frac{118+120}{2}} = \frac{100}{119} = .84$	- - -	- - -
49	- - -	- - -	$\frac{215}{\frac{234+244}{2}} = \frac{215}{239} = .90$
53	- - -	$\frac{53}{\frac{67+67}{2}} = \frac{53}{67} = .79$	- - -
57	$\frac{85}{\frac{90+90}{2}} = \frac{85}{90} = .94$	- - -	- - -
63	- - -	$\frac{115}{\frac{146+148}{2}} = \frac{115}{147} = .78$	- - -
67	- - -	$\frac{120}{\frac{139+138}{2}} = \frac{120}{138} = .87$	- - -
74	- - -	- - -	$\frac{105}{\frac{117+120}{2}} = \frac{105}{118} = .88$
79	$\frac{125}{\frac{151+152}{2}} = \frac{125}{151} = .82$	- - -	- - -
	$\overline{X} = .88$	$\overline{X} = .82$	$\overline{X} = .90$

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* This transcript was redone by each coder since the first reliability result was less than .80 (the minimum acceptability level).

Coder Reliability Data

Smith & Meux System

Transcript Number	Coder pair comparisons		
	Bill - Anne	Bill - Dan	Anne - Dan
7	- - -	$\frac{187}{\frac{239+227}{2}} = \frac{187}{233} = .80$	- - -
10	$\frac{245}{\frac{291+313}{2}} = \frac{245}{302} = .81$	- - -	- - -
20	- - -	$\frac{140}{\frac{189+185}{2}} = \frac{140}{187} = .75$	- - -
22	- - -	- - -	$\frac{203}{\frac{263+251}{2}} = \frac{203}{257} = .79$
31	- - -	- - -	$\frac{95}{\frac{129+120}{2}} = \frac{95}{124} = .77$
32	- - -	$\frac{106}{\frac{147+153}{2}} = \frac{106}{150} = .71$	- - -
36	- - -	- - -	$\frac{201}{\frac{224+221}{2}} = \frac{201}{222} = .90$
37	$\frac{162}{\frac{178+192}{2}} = \frac{162}{185} = .88$	- - -	- - -
39	$\frac{104}{\frac{134+143}{2}} = \frac{104}{138} = .75$	- - -	- - -
48	- - -	$\frac{154}{\frac{201+199}{2}} = \frac{154}{200} = .77$	- - -
50	$\frac{126}{\frac{157+164}{2}} = \frac{126}{160} = .79$	- - -	- - -
58	- - -	- - -	$\frac{114}{\frac{167+145}{2}} = \frac{114}{156} = .73$
	$\bar{X} = .81$	$\bar{X} = .76$	$\bar{X} = .80$

APPENDIX F

Question-Answer Correspondence Raw Data

BLOOM TAXONOMY

Correspondence Matrix for Overall Frequencies

	Cognitive categories	Student answers										
		A	B	C	D	E	F	G	H	I	J	Σ
Teacher questions	A- No category	180	80	1	-	2	132	-	8	147	24	574
	B- Knowledge of specifics	22	502	5	-	-	57	1	7	32	8	634
	C- Knowledge of ways & means	-	5	10	-	-	3	-	1	2	1	22
	D- Knowledge of universals & abstractions	-	-	-	-	-	-	-	-	-	-	-
	E- Translation	6	4	-	-	13	9	-	1	5	1	39
	F- Interpretation	48	122	5	-	1	510	-	8	167	29	890
	G- Application	-	-	-	-	-	-	-	-	1	-	1
	H- Analysis	4	4	-	-	-	5	-	13	4	1	31
	I- Synthesis	42	78	2	1	-	193	-	6	405	34	761
	J- Evaluation	11	13	1	1	-	30	-	2	39	92	189
	Σ											3141

BLOOM TAXONOMY

OVERALL CORRESPONDENCE DATA

Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
No Category	180	574	(18.3)	31.4
Knowledge of Specifics	502	634	(20.2)	79.2
Knowledge of Ways & Means	10	22	(0.7)	45.4
Knowledge of Universals & Abstractions	-	-	-	-
Translation	13	39	(1.2)	33.3
Interpretation	510	890	(28.4)	57.3
Application	-	1	(0.0)	0.0
Analysis	13	31	(1.0)	41.9
Synthesis	405	761	(24.2)	53.2
Evaluation	92	189	(6.0)	48.7

$\Sigma = 3141$

BLOOM TAXONOMY

GRADES 4-6 CORRESPONDENCE DATA

Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
No Category	120	323	(18.1)	37.2
Knowledge of Specifics	330	383	(21.4)	86.2
Knowledge of Ways & Means	3	5	(0.3)	60.0
Knowledge of Universals & Abstractions	-	-	-	-
Translation	5	19	(1.1)	26.3
Interpretation	322	516	(28.9)	62.4
Application	-	-	-	-
Analysis	6	13	(0.7)	46.2
Synthesis	232	408	(22.8)	56.9
Evaluation	58	118	(6.6)	49.2

$\Sigma = 1785$

BLOOM TAXONOMY

GRADES 7-8 CORRESPONDENCE DATA

Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
No Category	60	251	(18.5)	23.9
Knowledge of Specifics	172	251	(18.5)	68.5
Knowledge of Ways & Means	7	17	(1.2)	41.2
Knowledge of Universals & Abstractions	-	-	-	-
Translation	8	20	(1.5)	40.0
Interpretation	188	374	(27.6)	50.3
Application	-	1	(0.1)	0.0
Analysis	7	18	(1.3)	38.9
Synthesis	173	353	(26.0)	49.0
Evaluation	34	71	(5.2)	47.9

$\Sigma = 1356$

BLOOM TAXONOMY

RATINGS 1/2 CORRESPONDENCE DATA

Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
No Category	-	-	-	-
Knowledge of Specifics	59	99	(11.4)	59.6
Knowledge of Ways & Means	1	7	(0.8)	14.3
Knowledge of Universals & Abstractions	-	-	-	-
Translation	4	17	(1.9)	23.5
Interpretation	146	303	(34.7)	48.2
Application	-	1	(0.1)	0.0
Analysis	5	18	(2.1)	27.8
Synthesis	141	326	(37.4)	43.2
Evaluation	50	101	(11.6)	49.5

$\Sigma = 872$

BLOOM TAXONOMY

Percent Correspondence Matrix for Ratings 3/4

	Cognitive categories	Student answers									
		A	B	C	D	E	F	G	H	I	J
Teacher questions	A- No category	-	-	-	-	-	-	-	-	-	-
	B- Knowledge of specifics	3.2	82.8	0.7	0.0	0.0	7.3	0.2	0.6	4.3	0.9
	C- Knowledge of ways & means	0.0	26.7	60.0	0.0	0.0	6.7	0.0	0.0	6.7	6.7
	D- Knowledge of universals & abstractions	-	-	-	-	-	-	-	-	-	-
	E- Translation	13.0	4.3	0.0	0.0	40.9	21.7	0.0	4.3	13.0	4.3
	F- Interpretation	4.8	14.0	0.2	0.0	0.0	62.0	0.0	1.0	15.0	3.1
	G- Application	-	-	-	-	-	-	-	-	-	-
	H- Analysis	7.7	0.0	0.0	0.0	0.0	15.4	0.0	61.5	15.4	0.0
	I- Synthesis	6.0	8.3	0.2	0.0	0.0	19.4	0.0	0.5	60.7	4.6
	J- Evaluation	4.5	7.9	0.0	1.1	0.0	17.0	0.0	2.3	19.3	47.7

BLOOM TAXONOMY

RATINGS 3/4 CORRESPONDENCE DATA

Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
No Category	-	-	-	-
Knowledge of Specifics	443	535	(31.6)	82.8
Knowledge of Ways & means	9	15	(0.9)	60.0
Knowledge of Universals & Abstractions	-	-	-	-
Translation	9	22	(1.3)	40.9
Interpretation	364	587	(34.6)	62.0
Application	-	-	-	-
Analysis	8	13	(0.8)	61.5
Synthesis	264	435	(25.7)	60.7
Evaluation	42	88	(5.2)	47.7

$\Sigma = 1695$

BLOOM TAXONOMY

GRADES 4-6 AND RATINGS 1/2 CORRESPONDENCE DATA

Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
No Category	-	-	-	-
Knowledge of Specifics	36	53	(11.4)	67.9
Knowledge of Ways & Means	1	2	(0.4)	50.0
Knowledge of Universals & Abstractions	-	-	-	-
Translation	2	6	(1.3)	33.3
Interpretation	91	170	(36.6)	53.5
Application	-	-	-	-
Analysis	1	3	(0.6)	33.3
Synthesis	79	174	(37.4)	45.4
Evaluation	28	57	(12.2)	49.1

Σ = 465

BLOOM TAXONOMY

GRADES 4-6 AND RATINGS 3/4 CORRESPONDENCE DATA

Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
No Category	-	-	-	-
Knowledge of Specifics	294	330	(33.1)	89.1
Knowledge of Ways & Means	2	3	(0.3)	66.7
Knowledge of Universals & Abstractions	-	-	-	-
Translation	3	13	(1.3)	23.1
Interpretation	231	346	(34.7)	66.8
Application	-	-	-	-
Analysis	5	10	(1.0)	50.0
Synthesis	153	234	(23.5)	65.4
Evaluation	30	61	(6.1)	49.2

$\Sigma = 997$

BLOOM TAXONOMY

GRADES 7-8 AND RATINGS 1/2 CORRESPONDENCE DATA

Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
No Category	-	-	-	-
Knowledge of Specifics	23	46	(11.3)	50.0
Knowledge of Ways & Means	-	5	(1.2)	0.0
Knowledge of Universals & Abstractions	-	-	-	-
Translation	2	11	(2.7)	18.2
Interpretation	55	134	(32.8)	41.0
Application	-	1	(0.2)	0.0
Analysis	4	15	(3.7)	26.7
Synthesis	62	152	(37.2)	40.8
Evaluation	22	44	(10.8)	50.0

$\Sigma = 408$

BLOOM TAXONOMY

GRADES 7-8 AND RATINGS 3/4 CORRESPONDENCE DATA

Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
No Category	-	-	-	-
Knowledge of Specifics	149	205	(29.4)	72.7
Knowledge of Ways & Means	7	12	(1.7)	58.3
Knowledge of Universals & Abstractions	-	-	-	-
Translation	6	9	(1.3)	66.7
Interpretation	133	240	(34.4)	55.4
Application	-	-	-	-
Analysis	3	3	(0.4)	100.0
Synthesis	111	201	(28.8)	55.2
Evaluation	12	27	(3.9)	44.4

Σ = 697

ASCHNER-GALLAGHER SYSTEM

Correspondence Matrix for Overall Frequencies

	Cognitive categories	Student answers																			Σ
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	
Teacher questions	A- No category	3	-	-	2	-	1	1	3	-	-	-	-	-	-	-	-	1	1	-	12
	B- Management	-	-	-	3	-	3	-	2	-	1	5	-	5	3	-	1	-	2	-	25
	C- Structuring	19	1	4	26	-	17	13	22	2	7	20	8	11	3	-	1	2	17	2	175
	D- Verdict	2	-	-	37	-	4	6	4	-	1	6	2	9	1	2	2	1	2	1	80
	E- Scribe	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	F- Recapitulation	1	-	-	9	-	53	4	6	-	2	7	3	7	3	-	-	1	4	-	100
	G- Clarification	2	-	1	27	-	10	100	14	1	3	11	6	14	5	4	6	4	11	1	220
	H- Factual	2	-	-	12	-	19	14	337	-	9	8	9	13	2	3	1	4	3	1	437
	I- Translation	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	2	-	4
	J- Association	-	-	-	9	-	5	9	18	-	108	10	5	9	4	-	-	2	-	1	180
	K- Explanation	2	1	4	18	-	28	16	15	-	15	370	8	37	15	9	3	15	21	2	579
	L- Conclusion	-	-	1	15	-	14	9	4	-	2	7	123	9	5	1	1	3	4	-	198
	M- Unstructured	2	2	-	12	-	11	4	8	-	4	4	5	175	10	18	6	5	10	-	276
	N- Structured	1	-	-	9	-	7	5	4	-	4	5	2	13	87	12	-	1	7	1	158
	O- Qualification	-	-	-	-	-	1	1	2	-	-	-	-	-	1	4	-	-	-	-	9
	P- Elaboration	-	-	-	8	-	2	1	1	-	1	-	-	1	-	-	14	1	1	-	30
	Q- Divergent association	-	-	1	1	-	1	1	1	-	-	-	2	-	-	-	-	9	-	-	16
	R- Implication	5	-	2	15	-	14	9	7	2	1	7	1	22	8	10	3	11	160	1	278
	S- Synthesis	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
	Σ																				2779

ASCHNER-GALLAGHER SYSTEM

OVERALL CORRESPONDENCE DATA

	Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
	No Category	3	12	(0.4)	25.0
Routine	Management	-	25	(0.9)	0.0
	Structuring	4	175	(6.3)	2.3
	Verdict	37	80	(2.9)	46.2
Memory	Scribe	-	-	-	-
	Recapitulation	53	100	(3.6)	53.0
	Clarification	100	220	(7.9)	45.4
	Factual	337	437	(15.7)	77.1
Convergent	Translation	2	4	(0.1)	50.0
	Association	108	180	(6.5)	60.0
	Explanation	370	579	(20.8)	63.9
	Conclusion	123	198	(7.1)	62.1
Evaluative	Unstructured	175	276	(9.9)	63.4
	Structured	87	158	(5.7)	55.1
	Qualification	4	9	(0.3)	44.4
Divergent	Elaboration	14	30	(1.1)	46.7
	Divergent Association	9	16	(0.6)	56.2
	Implication	160	278	(10.0)	57.6
	Synthesis	1	2	(0.1)	50.0

$\Sigma = 2779$

ASCHNER-GALLAGHER SYSTEM

GRADES 4-6 CORRESPONDENCE DATA

	Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
	No Category	1	5	(0.3)	20.0
Routine	Management	-	12	(0.7)	0.0
	Structuring	3	114	(7.0)	2.6
	Verdict	19	37	(2.3)	51.4
Memory	Scribe	-	-	-	-
	Recapitulation	36	62	(3.8)	58.1
	Clarification	51	105	(6.4)	48.6
	Factual	212	262	(16.0)	80.9
Convergent	Translation	2	4	(0.1)	50.0
	Association	79	127	(7.8)	62.2
	Explanation	249	380	(23.3)	65.5
	Conclusion	71	104	(6.4)	68.3
Evaluative	Unstructured	124	178	(10.9)	69.7
	Structured	43	74	(4.5)	58.1
	Qualification	2	4	(0.2)	50.0
Divergent	Elaboration	5	15	(0.9)	33.3
	Divergent Association	6	9	(0.6)	66.7
	Implication	92	141	(8.6)	65.2
	Synthesis	1	1	(0.1)	100.0

Σ = 1634

ASCHNER-GALLAGHER SYSTEM

GRADES 7-8 CORRESPONDENCE DATA

	Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
	No Category	2	7	(0.6)	28.6
Routine	Management	-	13	(1.1)	0.0
	Structuring	1	61	(5.3)	1.6
	Verdict	18	43	(3.7)	41.9
Memory	Scribe	-	-	-	-
	Recapitulation	17	38	(3.3)	44.7
	Clarification	49	115	(10.0)	42.6
	Factual	125	175	(15.2)	71.4
Convergent	Translation	-	-	-	-
	Association	29	53	(4.6)	54.7
	Explanation	121	199	(17.3)	60.8
	Conclusion	52	94	(8.2)	55.3
Evaluative	Unstructured	51	98	(8.5)	52.0
	Structured	44	84	(7.3)	52.4
	Qualification	2	5	(0.4)	40.0
Divergent	Elaboration	9	15	(1.3)	60.0
	Divergent Association	3	7	(0.6)	42.8
	Implication	68	137	(11.9)	49.6
	Synthesis	-	1	(0.1)	0.0

Σ = 1145

ASCHNER-GALLAGHER SYSTEM

RATINGS 1/2 CORRESPONDENCE DATA

	Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
	No Category	-	-	-	-
Routine	Management	-	-	-	-
	Structuring	-	37	(10.1)	0.0
	Verdict	1	2	(0.5)	50.0
Memory	Scribe	-	-	-	-
	Recapitulation	2	5	(1.4)	40.0
	Clarification	5	15	(4.1)	33.3
	Factual	24	39	(10.7)	61.5
Convergent	Translation	2	4	(1.1)	50.0
	Association	6	19	(5.2)	31.6
	Explanation	9	19	(5.2)	47.4
	Conclusion	19	31	(8.5)	61.3
Evaluative	Unstructured	8	15	(4.1)	53.3
	Structured	2	8	(2.2)	25.0
	Qualification	-	1	(0.3)	0.0
Divergent	Elaboration	1	3	(0.8)	33.3
	Divergent Association	3	7	(1.9)	42.8
	Implication	82	158	(43.3)	51.9
	Synthesis	1	2	(0.5)	50.0

$\Sigma = 365$

ASCHNER-GALLAGHER SYSTEM

Percent Correspondence Matrix for Ratings 3/4

Teacher questions

Cognitive categories	Student answers																		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
A- No category	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B- Management	0.0	0.0	0.0	12.0	0.0	12.0	0.0	8.0	0.0	4.0	20.0	0.0	20.0	12.0	0.0	4.0	0.0	8.0	0.0
C- Structuring	1.4	0.7	2.9	17.4	0.0	10.9	7.2	13.0	1.4	5.1	13.0	2.2	8.0	2.2	0.0	0.7	1.4	10.9	1.4
D- Verdict	2.6	0.0	0.0	46.2	0.0	5.1	7.7	5.1	0.0	1.3	7.7	2.6	11.5	1.3	2.6	1.3	1.3	2.6	1.3
E- Scribe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F- Recapitulation	1.0	0.0	0.0	8.4	0.0	53.7	4.2	5.3	0.0	2.1	7.4	3.2	6.3	3.2	0.0	0.0	1.0	4.2	0.0
G- Clarification	1.0	0.0	0.5	11.7	0.0	3.9	46.3	6.3	0.5	1.5	5.4	2.9	6.3	2.0	2.0	2.4	1.5	5.4	0.5
H- Factual	0.0	0.0	0.0	2.0	0.0	4.0	3.5	78.6	0.0	2.0	1.5	2.2	2.8	0.5	0.8	0.2	0.8	0.8	0.2
I- Translation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
J- Association	0.0	0.0	0.0	5.0	0.0	2.5	3.1	9.9	0.0	63.4	6.2	2.5	3.7	2.5	0.0	0.0	0.6	0.0	0.6
K- Explanation	0.4	0.2	0.7	4.7	0.0	4.4	2.8	2.6	0.0	2.4	64.5	1.4	6.5	2.6	1.6	0.5	2.3	3.2	0.4
L- Conclusion	0.0	0.0	0.6	9.0	0.0	7.8	3.6	0.0	0.0	1.2	3.6	62.3	4.8	2.4	0.6	0.6	1.2	2.4	0.0
M- Unstructured	0.8	0.4	0.0	3.8	0.0	4.2	1.1	2.3	0.0	1.1	1.5	1.9	64.0	3.8	6.9	2.3	1.9	3.8	0.0
N- Structured	0.0	0.0	0.0	5.3	0.0	4.7	3.3	2.7	0.0	2.7	2.7	1.3	7.3	56.7	8.0	0.0	0.7	4.0	0.7
O- Qualification	0.0	0.0	0.0	0.0	0.0	12.5	12.5	12.5	0.0	0.0	0.0	0.0	0.0	12.5	50.0	0.0	0.0	0.0	0.0
P- Elaboration	0.0	0.0	0.0	22.2	0.0	7.4	3.7	3.7	0.0	3.7	0.0	0.0	3.7	0.0	0.0	48.1	3.7	3.7	0.0
Q- Divergent association	0.0	0.0	11.1	0.0	0.0	11.1	0.0	11.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.7	0.0	0.0
R- Implication	0.0	0.0	0.8	5.8	0.0	1.7	2.5	1.7	1.7	0.0	2.5	0.8	5.8	1.7	1.7	1.7	6.7	65.0	0.0
S- Synthesis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ASCHNER-GALLAGHER SYSTEM

RATINGS 3/4 CORRESPONDENCE DATA

	Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
	No Category	-	-	-	-
Routine	Management	-	25	(1.0)	0.0
	Structuring	4	138	(5.7)	2.9
	Verdict	36	78	(3.2)	46.2
Memory	Scribe	-	-	-	-
	Recapitulation	51	95	(4.0)	53.7
	Clarification	95	205	(8.5)	46.3
	Factual	313	398	(16.6)	78.6
Convergent	Translation	-	-	-	-
	Association	102	161	(6.7)	63.4
	Explanation	361	560	(23.3)	64.5
	Conclusion	104	167	(7.0)	62.3
Evaluative	Unstructured	167	261	(10.9)	64.0
	Structured	85	150	(6.2)	56.7
	Qualification	4	8	(0.3)	50.0
Divergent	Elaboration	13	27	(1.1)	48.1
	Divergent Association	6	9	(0.4)	66.7
	Implication	78	120	(5.0)	65.0
	Synthesis	-	-	-	-

$\Sigma = 2402$

ASCHNER-GALLAGHER SYSTEM

GRADES 4-6 AND RATINGS 1/2 CORRESPONDENCE DATA

Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
No Category	-	-	-	-
Management	-	-	-	-
Structuring	-	31	(16.1)	0.0
Verdict	-	-	-	-
Scribe	-	-	-	-
Recapitulation	1	3	(1.6)	33.3
Clarification	2	5	(2.6)	40.0
Factual	18	26	(13.5)	69.2
Translation	2	4	(2.1)	50.0
Association	4	13	(6.8)	30.8
Explanation	8	14	(7.3)	57.1
Conclusion	9	13	(6.8)	69.2
Unstructured	4	7	(3.6)	57.1
Structured	1	1	(0.5)	100.0
Qualification	-	-	-	-
Elaboration	-	2	(1.0)	0.0
Divergent Association	2	3	(1.6)	66.7
Implication	44	69	(35.9)	63.8
Synthesis	1	1	(0.5)	100.0

$\Sigma = 192$

ASCHNER-GALLAGHER SYSTEM

GRADES 4-6 AND RATINGS 3/4 CORRESPONDENCE DATA

	Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
	No Category	-	-	-	-
Routine	Management	-	12	(0.8)	0.0
	Structuring	3	83	(5.8)	3.6
	Verdict	19	37	(2.6)	51.4
Memory	Scribe	-	-	-	-
	Recapitulation	35	59	(4.1)	59.3
	Clarification	49	100	(7.0)	49.0
	Factual	194	236	(16.4)	82.2
Convergent	Translation	-	-	-	-
	Association	75	114	(7.9)	65.8
	Explanation	241	366	(25.5)	65.8
	Conclusion	62	91	(6.3)	68.1
Evaluative	Unstructured	120	171	(11.9)	70.2
	Structured	42	73	(5.1)	57.5
	Qualification	2	4	(0.3)	50.0
Divergent	Elaboration	5	13	(0.9)	38.5
	Divergent Association	4	6	(0.4)	66.7
	Implication	48	72	(5.0)	66.7
	Synthesis	-	-	-	-

$\Sigma = 1437$

ASCHNER-GALLAGHER SYSTEM

GRADES 7-8 AND RATINGS 1/2 CORRESPONDENCE DATA

	Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
	No Category	-	-	-	-
Routine	Management	-	-	-	-
	Structuring	-	6	(3.5)	0.0
	Verdict	1	2	(1.2)	50.0
Memory	Scribe	-	-	-	-
	Recapitulation	1	2	(1.2)	50.0
	Clarification	3	10	(5.8)	30.0
	Factual	6	13	(7.5)	46.2
Convergent	Translation	-	-	-	-
	Association	2	6	(3.5)	33.3
	Explanation	1	5	(2.9)	20.0
	Conclusion	10	18	(10.4)	55.6
Evaluative	Unstructured	4	8	(4.6)	50.0
	Structured	1	7	(4.0)	14.3
	Qualification	-	1	(0.6)	0.0
Divergent	Elabcration	1	1	(0.6)	100.0
	Divergent Association	1	4	(2.3)	25.0
	Implication	38	89	(51.4)	42.7
	Synthesis	-	1	(0.6)	0.0

$\Sigma = 173$

ASCHNER-GALLAGHER SYSTEM

GRADES 7-8 AND RATINGS 3/4 CORRESPONDENCE DATA

	Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
	No Category	-	-	-	-
Routine	Management	-	13	(1.3)	0.0
	Structuring	1	55	(5.7)	1.8
	Verdict	17	41	(4.2)	41.5
Memory	Scribe	-	-	-	-
	Recapitulation	16	36	(3.7)	44.4
	Clarification	46	105	(10.9)	43.8
	Factual	119	162	(16.8)	73.4
Convergent	Translation	-	-	-	-
	Association	27	47	(4.9)	57.4
	Explanation	120	194	(20.1)	61.8
	Conclusion	42	76	(7.8)	55.3
Evaluative	Unstructured	47	90	(9.2)	52.2
	Structured	43	77	(7.9)	55.8
	Qualification	2	4	(0.4)	50.0
Divergent	Elaboration	8	14	(1.4)	57.1
	Divergent Association	2	3	(0.3)	66.7
	Implication	30	48	(5.0)	62.5
	Synthesis	-	-	-	-

Σ = 965

SMITH & MEUX SYSTEM

Correspondence Matrix for Overall Frequencies

Teacher questions

Cognitive categories	Student answers A	B	C	D	E	F	G	H	I	J	K	L	M	N	Σ
A- No category	249	1	25	9	1	8	0	7	18	0	2	12	9	-	341
B- Defining	11	46	2	1	0	0	0	0	0	0	0	3	2	-	65
C- Describing	123	0	489	26	0	20	1	16	50	0	7	15	33	-	780
D- Designating	31	1	32	169	0	6	0	4	7	2	0	2	2	-	256
E- Stating	2	0	0	0	1	2	0	1	0	0	0	1	0	-	7
F- Reporting	12	0	16	6	0	99	0	2	9	0	2	2	2	-	150
G- Substituting	0	1	0	0	0	0	3	0	0	0	0	1	0	-	5
H- Evaluating	51	0	9	3	0	6	0	134	53	0	3	13	17	-	289
I- Opining	111	0	60	5	0	10	0	64	328	1	7	41	52	-	679
J- Classifying	0	0	0	2	0	0	0	0	1	2	0	0	0	-	5
K- Comparing/ contrasting	25	0	11	0	0	5	0	6	7	0	70	6	7	-	137
L- Conditional inferring	29	0	15	2	0	3	0	4	24	0	0	64	12	-	153
M- Explaining	131	1	44	9	0	8	0	21	45	0	7	44	306	-	616
N- Directing & managing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Σ															3483

SMITH & MEUX SYSTEM

OVERALL CORRESPONDENCE DATA

Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
[illegible] Category	249	341	(9.8)	73.0
Directing & Managing	-	-	-	-
Defining	46	65	(1.9)	70.8
Describing	489	780	(22.4)	62.7
Designating	169	256	(7.3)	66.0
Stating	1	7	(0.2)	14.3
Reporting	99	150	(4.3)	66.0
Substituting	3	5	(0.1)	60.0
Evaluating	134	289	(8.3)	46.4
Opining	328	679	(19.5)	48.3
Classifying	2	5	(0.1)	40.0
Comparing/ Contrasting	70	137	(3.9)	51.1
Conditional Inferring	64	153	(4.4)	41.8
Explaining	306	616	(17.7)	49.7

$\Sigma = 3483$

SMITH & MEUX SYSTEM

GRADES 4-6 CORRESPONDENCE DATA

Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
No Category	133	176	(8.4)	75.6
Directing & Managing	-	-	-	-
Defining	30	46	(2.2)	65.2
Describing	311	476	(22.6)	65.3
Designating	105	154	(7.3)	68.2
Stating	-	1	(0.0)	0.0
Reporting	53	86	(4.1)	61.6
Substituting	2	3	(0.1)	66.7
Evaluating	85	184	(8.8)	46.2
Opining	196	388	(18.4)	50.5
Classifying	1	2	(0.1)	50.0
Comparing/ Contrasting	56	104	(4.9)	53.8
Conditional Inferring	39	83	(3.9)	47.0
Explaining	205	399	(19.0)	51.4

$\Sigma = 2102$

SMITH & MEUX SYSTEM

GRADES 7-8 CORRESPONDENCE DATA

Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
No Category	116	165	(11.9)	70.3
Directing & Managing	-	-	-	-
Defining	16	19	(1.4)	84.2
Describing	178	304	(22.0)	58.6
Designating	64	102	(7.4)	62.7
Stating	1	6	(0.4)	16.7
Reporting	46	64	(4.6)	71.9
Substituting	1	2	(0.1)	50.0
Evaluating	49	105	(7.6)	46.7
Opining	132	291	(21.1)	45.4
Classifying	1	3	(0.2)	33.3
Comparing/ Contrasting	14	33	(2.4)	42.4
Conditional Inferring	25	70	(5.1)	35.7
Explaining	101	217	(15.7)	46.5

$\Sigma =$ 1381

SMITH & MEUX SYSTEM

RATINGS 1/2 CORRESPONDENCE DATA

Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
No Category	-	-	-	-
Directing & Managing	-	-	-	-
Defining	2	4	(0.4)	50.0
Describing	121	228	(24.2)	53.1
Designating	7	21	(2.2)	33.3
Stating	-	4	(0.4)	0.0
Reporting	11	26	(2.8)	42.3
Substituting	-	-	-	-
Evaluating	63	155	(16.4)	40.6
Opining	118	282	(29.9)	41.8
Classifying	-	-	-	-
Comparing/ Contrasting	4	11	(1.2)	36.4
Conditional Inferring	13	41	(4.3)	31.7
Explaining	73	172	(18.2)	42.4

$\Sigma = 944$

SMITH & MEUX SYSTEM

Percent Correspondence Matrix for Ratings 3/4

Teacher questions

Cognitive categories	Student answers													
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
A- No category	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B- Defining	16.4	72.1	3.3	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	1.6	-
C- Describing	14.7	0.0	66.7	3.8	0.0	2.4	0.0	2.2	4.5	0.0	0.9	2.0	2.7	-
D- Designating	11.5	0.0	11.1	68.9	0.0	2.1	0.0	1.3	3.0	0.4	0.0	0.8	0.4	-
E- Stating	33.3	[illegible].3	0.0	0.0	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
F- Reporting	7.2	0.0	7.2	4.0	0.0	71.0	0.0	1.6	4.0	0.0	1.6	1.6	1.6	-
G- Substituting	0.0	0.0	0.0	0.0	0.0	0.0	60.0	0.0	0.0	0.0	0.0	20.0	20.0	-
H- Evaluating	20.1	0.7	3.7	1.5	0.0	3.0	0.0	53.0	3.7	0.0	0.0	4.5	9.7	-
I- Opining	17.9	0.0	7.6	1.0	0.0	1.8	0.0	2.5	52.9	0.0	1.2	8.1	7.0	-
J- Classifying	0.0	0.0	0.0	40.0	0.0	0.0	0.0	0.0	20.0	40.0	0.0	0.0	0.0	-
K- Comparing/ contrasting	18.2	0.0	7.1	0.0	0.0	4.0	0.0	3.2	5.6	0.0	52.4	4.8	4.8	-
L- Conditional inferring	19.6	0.0	9.8	1.8	0.0	0.9	0.0	3.6	14.3	0.0	0.0	45.5	4.5	-
M- Explaining	21.4	0.2	5.2	0.4	0.0	1.3	0.0	2.9	6.8	0.0	0.9	8.3	52.5	-
N- Directing & managing	-	-	-	-	-	-	-	-	-	-	-	-	-	-

SMITH & MEUX SYSTEM

RATINGS 3/4 CORRESPONDENCE DATA

Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
No Category	-	-	-	-
Directing & Managing	-	-	-	-
Defining	44	61	(2.8)	72.1
Describing	368	552	(25.1)	66.7
Designating	162	235	(10.7)	68.9
Stating	1	3	(0.1)	33.3
Reporting	88	124	(5.6)	71.0
Substituting	3	5	(0.2)	60.0
Evaluating	71	134	(6.1)	53.0
Opining	210	397	(18.1)	52.9
Classifying	2	5	(0.2)	40.0
Comparing/ Contrasting	66	126	(5.7)	52.4
Conditional Inferring	51	112	(5.1)	45.5
Explaining	233	444	(20.2)	52.5

Σ = 2198

SMITH & MEUX SYSTEM

GRADES 4-6 AND RATINGS 1/2 CORRESPONDENCE DATA

Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
No Category	-	-	-	-
Directing & Managing	-	-	-	-
Defining	1	2	(0.4)	50.0
Describing	83	146	(26.5)	56.8
Designating	4	12	(2.2)	33.3
Stating	-	-	-	-
Reporting	6	14	(2.5)	42.8
Substituting	-	-	-	-
Evaluating	38	94	(17.0)	40.4
Opining	73	161	(29.2)	45.3
Classifying	-	-	-	-
Comparing/ Contrasting	4	9	(1.6)	44.4
Conditional Inferring	5	15	(2.7)	33.3
Explaining	46	98	(17.8)	46.9

$\Sigma = 551$

SMITH & MEUX SYSTEM

GRADES 4-6 AND RATINGS 3/4 CORRESPONDENCE DATA

Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
No Category	-	-	-	-
Directing & Managing	-	-	-	-
Defining	29	44	(3.2)	65.9
Describing	228	330	(24.0)	69.1
Designating	101	142	(10.3)	71.1
Stating	-	1	(0.1)	0.0
Reporting	47	72	(5.2)	65.3
Substituting	2	3	(0.2)	66.7
Evaluating	47	90	(6.5)	52.2
Opining	123	227	(16.5)	54.2
Classifying	1	2	(0.1)	50.0
Comparing/ Contrasting	52	95	(6.9)	54.7
Conditional Inferring	34	68	(4.9)	50.0
Explaining	159	301	(21.9)	52.8

$\Sigma = 1375$

SMITH & MEUX SYSTEM

GRADES 7-8 AND RATINGS 1/2 CORRESPONDENCE DATA

Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
No Category	-	-	-	-
Directing & Managing	-	-	-	-
Defining	1	2	(0.5)	50.0
Describing	38	82	(20.9)	46.3
Designating	3	9	(2.3)	33.3
Stating	-	4	(1.0)	0.0
Reporting	5	12	(3.1)	41.7
Substituting	-	-	-	-
Evaluating	25	61	(15.5)	41.0
Opining	45	121	(30.8)	37.2
Classifying	-	-	-	-
Comparing/ Contrasting	-	2	(0.5)	0.0
Conditional Inferring	8	26	(6.6)	30.8
Explaining	27	74	(18.8)	36.5

$\Sigma = 393$

SMITH & MEUX SYSTEM

GRADES 7-8 AND RATINGS 3/4 CORRESPONDENCE DATA

Cognitive Categories	Number of Question/Answer Correspondences	Number of Teacher Questions	% of Total Teacher Questions	% one-to-one Question/Answer Correspondences
No Category	-	-	-	-
Directing & Managing	-	-	-	-
Defining	14	16	(1.9)	87.5
Describing	140	222	(27.0)	63.1
Designating	61	93	(11.3)	65.6
Stating	1	2	(0.2)	50.0
Reporting	41	52	(6.3)	78.8
Substituting	1	2	(0.2)	50.0
Evaluating	24	44	(5.3)	54.5
Opining	87	170	(20.6)	51.2
Classifying	1	3	(0.4)	33.3
Comparing/ Contrasting	14	31	(3.8)	45.2
Conditional Inferring	17	44	(5.3)	38.6
Explaining	74	143	(17.4)	51.7

$\Sigma = 823$

APPENDIX B

Cognitive Classification Systems:

Bloom Taxonomy

Aschner-Gallagher System

Smith and Meux System

BLOOM TAXONOMY (MODIFIED)

FLORIDA TAXONOMY OF COGNITIVE BEHAVIOR

TOT							
T	P	T/ P	T/ P	T/ P	T/ P	T/ P	1.10 KNOWLEDGE OF SPECIFICS
							1. Reads
							2. Spells
							3. Identifies something by name
							4. Defines meaning of term
							5. Gives a specific fact
							6. Tells about an event
							1.20 KNOWLEDGE OF WAYS AND MEANS OF DEALING WITH SPECIFICS
							7. Recognizes symbol
							8. Cites rule
							9. Gives chronological sequence
							10. Gives steps of process, describes method
							11. Cites trend
							12. Names classification system or standard
							13. Names what fits given system or standard
							1.30 KNOWLEDGE OF UNIVERSALS AND ABSTRACTIONS
							14. States generalized concept or idea
							15. States a principle, law, theory
							16. Tells about orgnztn or structure
							17. Recalls name of prin, law, theory
/							2.00 TRANSLATION
							18. Restates in own words or briefer terms
							19. Gives cncrt exmpl of an abstract idea
							20. Verbalizes from a graphic rprsntatn
							21. Trans vrblztn into graphic form
							22. Trans fig stmnts to lit stmnts, or vice v
							23. Trans for lang to Eng, or vice versa

FLORIDA TAXONOMY OF COGNITIVE BEHAVIOR

TOT							
T	P	T/ P	T/ P	T/ P	T/ P	T/ P	3.00 INTERPRETATION
							24. Gives reason (tells why)
							25. Shows similarities, diffrncs
							26. Summarizes or concludes frm obs of evdnce
							27. Shows cause and effect rltnshp
							28. Gives analogy, simile, metaphor
							29. Performs a directed task or process
							4.00 APPLICATION
							30. Applies previous learning to new sitn
							31. Applies principle to new situation
							32. Apply abstrct knldg in a prctcl sitn
							33. Idntifs, selects, and carries out process
							5.00 ANALYSIS
							34. Distngshs fact from opinion
							35. Distngshs fact from hypothesis
							36. Distngshs cnclsn frm stmnts wch suppt it
							37. Points out unstated assumption
							38. Shows interaction or relation of elements
							39. Points out prticlrs to jstfy cnclsn
							40. Checks hypthss with given info
							41. Dstngshs rel frm irrelvnt stmnts
							42. Detects error in thinking
							43. Infers prpse, pt of view, thghts, feelings
							44. Recog bias or propaganda
							6.00 SYNTHESIS (Creativity)
							45. Reorganizes ideas, materials, process
							46. Produces unique cmmnctn, divergent idea
							47. Produces a plan, prpsd set of oprtns
							48. Designs an apparatus
							49. Designs a structure
							50. Devises scheme for classifying info
							51. Formulates hypothesis, intelligent guess
							52. Mks dedctns frm abstrct smbls, propostns
							53. Draws inductive generalizatn frm specifcs
							7.00 EVALUATION
							54. Evaluates something from evdnce
							55. Evaluated something from criteria

ASCHNER-GALLAGHER SYSTEM

TABLE OF CATEGORIES

WITH SHORT DEFINITIONS

I. ROUTINE (R)

This category includes routine classroom procedural matters such as management of the classroom, the structuring of class discussion and approval or disapproval of the idea or the person

		Page
MANAGEMENT		1
Mq	- Question: Requests or invitations to speak; calling for questions, as in "Anybody have a question?"	1
Mp	- Procedure: Announcements or procedural instructions, given or requested for individuals or the group as a whole	2
Ma	- Aside: Incidental or parenthetical comment; gratuitous content	2
Mnc	- Nose-Counting: Calling for or responding with a show of hands for a tally or canvas	3
Mfb	- Feedback: Request for or response with signs from group as to whether or not the speaker's actions or remarks are clearly understood	3
Mw	- Work: Non-verbal actions or seatwork going on in connection with current discussion or class proceedings	3
X	- Unclassifiable response primarily due to technical recording difficulties	
STRUCTURING		4
Sts	- Self-Structuring: Conventional prefatory move to signal content and purport of one's own next remarks or behavior	4

Sto - Structuring Other(s): Engineering next speech or actions of other(s). Monitoring other's performance. Pump-priming to keep discussion going on a point already before the class . . . 5

Stf - Future Structuring: Forecast of future activity, study, learning, etc. beyond this particular class session. 6

Stc - Class Structuring: Focusing class attention on point to be emphasized or taken up; laying groundwork for question or problem; probing, pushing, adding data for bogged-down class (teacher only) 6

VERDICT. 7

Ver Verdict: (+ or -) Impersonal praise or reproach on quality of academic performance of individual or group 7

Verp - Personal Verdict: (+ or -) Personal praise or reproach of individual. (Occasionally by T on whole class) Negative Verp generally on deportment. 8

Agr - AGREEMENT: (+ or -) Acceptance or rejection of content; conceding a point; not permission-giving nor procedural 9

S - SELF REFERENCE: Speaker's personal report or comment upon or about self. Often conventional device; cautionary tactic . . . 10

Du - DUNNO: Explicit indication that one does not know 10

Mu - MUDDLED: Speaker confused, mixed up, flustered 11

Hu - HUMOR: Remark of evident witty, humorous, or comic intent; response (usually laughter) to same 11

II. COGNITIVE-MEMORY (C-M)

C-M operations represent the simple reproduction of facts, formulas and other items of remembered content through use of such processes as recognition, rote memory and selective recall.

Scr - SCRIBE: Giving a spoken or written spelling or exemplification of a word or expression 13

RECAPITULATION 13

Req - Quoting: Rote recitation or literal reading from text, paper or notes in hand 14

Rep - Repetition: Literal or nearly verbatim restatement of something just said 14

Rec - Recounting: Narration of past extra-class occurrence 14

Rev - Review: Recitation of material which occurred or was discussed in current or past class session 15

CLARIFICATION 16

Clm - Clarifying Meaning: Rendering a previous statement more intelligible either by (a) restating or rephrasing or (b) adding informative details. 16

Clq - Clarifying Qualification: Render a previous statement more accurate either by (a) "Entering a rider" upon the remark or (b) entering an explicit correction 17

FACTUAL 18

Fs - Fact Stating: Requests for and recitations of items taken to be matters of fact 18

Fd - Fact Detailing: Spinning out further a prior assertion of fact or other statement (As, Exr) in which factual items were mentioned 19

Fm - Factual Monologue: Reporting of factual material in the form of a monologue during which verbal exchange is conventionally excluded 20

III. CONVERGENT THINKING

Convergent thinking is thought operation involving the analysis and integration of given or remembered data. It leads to one expected result because of the tightly structured framework which limits it.

TRANSLATION 22

Tr - Translation: Shift of conceptual material from symbolic or figural content to semantic, or vice versa 23

ASSOCIATION 23

As - Association: Involving likenesses and differences; degrees of comparison; and relationships of direction, spatial position and/or classification, etc. 23

EXPLANATION 24

Exr - Rational Explanation: Asking or telling why X is the case; why Y caused X, etc. Substantiating a claim or conclusion by citing evidence 24

Exv - Value Explanation: Asking or telling why X is good, bad, useful, important, etc. Justifying a rating, viewpoint, or value-based judgment by giving reasons why 25

Exn - Narrative Explanation: Step-by-step account of how something is done, how a mechanism works, or of what led up to an event or given outcome. 26

CONCLUSION 26

Gen - Generalization: Integration of prior remarks by slightly more general reformulation 26

Cons - Summary Conclusion: Summary reformulation, often serial or enumerative, of material treated in discussion or reading . . . 27

Conl - Logical Conclusion: Calling for a deductively drawn implication from material presented 28

IV. EVALUATIVE THINKING (ET)

Evaluative thinking deals with matters of value rather than matters of fact and is characterized by verbal performance by its judgmental character.

UNSTRUCTURED 31

Ura - Unstructured Rating: A value judgment produced or requested on some idea or item in terms of a scale of values provided by the respondent. 31

Uju - Unstructured Judgment: A value judgment produced or requested on some idea or item wherein the value dimension has already been provided 32

STRUCTURED 32

Svp - Structured Probability: An estimate or speculative opinion is given or requested as to the likelihood of some occurrence or situation 32

Svc - Structured Choice: Speaker calls for or declares his position as a choice between alternatives (not between Yes or No answers) . . 33

QUALIFICATION 33

Qj - Qualified Judgment: An offer or request for a rider or modification to a prior value judgment. Also, attempts to make more precise the value dimension discussed 33

Q-c - Counter Judgment: Speaker declares a directly opposed position with respect to value statement of a previous classroom speaker. . 34

V. DIVERGENT THINKING (DT)

In a Divergent Thinking sequence, individuals are free to independently generate their own data within a data-poor situation, often taking a new direction or perspective.

El - Elaboration: Structured or free (s or f). Building upon a point already made; filling out or developing a point, but not shifting to a new point, often by concocting instances or examples 37

Ad - Divergent Association: (s or f) Constructing a relationship between ideas, casting the central idea into sharper and often unexpected perspective, by comparisons, analogies, etc. 38

Imp - Implication: (s or f) Extrapolation beyond the given, projection from given data--typically by antecedent--consequent or hypothetical construction--to new point(s) of possibility 39

Syn - Synthesis: Spontaneous performance, tying in, integrating the current central idea with an entirely new point or frame of reference. May be a variation or reversal of a previous conclusion 40

Double-paired Ratings: The complex nature of verbal classroom interaction often requires the combination of more than one of the above described categories. Samples of the more common combinations are given in the appendix.

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x - Aschner-Gallagher System

April, 1962 Version

ORGANIZATION OF CATEGORY SYSTEM

I. R ROUTINE		II. CM COGNITIVE MEMORY		III. CT CONVERGENT THINKING		IV. ET EVALUATIVE THINKING		V. DT DIVERGENT THINKING	
M	Mq	Scr		Tr		U	Ura	El	s/f
	Mp						Uju		
	Ma	Re	Req	As				Ad	s/f
	Mnc		Rep			S	Svp		
	Mfb		Rec	Ex	Exr		Svc	Imp	s/f
	Mw		Rev		Exv				
					Exn	Q	QJ	Syn	
St	Sts	Cl	Clm				Q-c		
	Sto		Clq	Con	Gen				
	Stf				Cons				
	Stc	F	Fs		Conl				
			Fd						
Ver	+l-		Fm						
Verp	+l-								
Agr	+l-								
S									
Du									
Mu									
Hu									

3. Kinds of Entries

The foregoing discussion is perhaps sufficient to indicate the way in which we arrived at a set of logical categories. The categories into which the entries were grouped are as follows:

1) Defining. Entries making up this group are concerned with how words or other symbols are used to refer to objects (abstract or concrete). These entries vary in form and content, but in general they ask implicitly or explicitly for the meaning of terms.

In some cases, a term is given and a definition or meaning of the term is to be supplied as a response to the entry. In the example, 'What does the word "dorsal" mean?', the question requires that whatever is designated by "dorsal" be indicated.

In other cases, neither the word 'mean' nor 'define' occurs in the entry. Rather the entry asks what the something is, for example, 'What is a cablegram?'. These entries require that the noun appearing in the question be defined, or that the referent of the noun be described.

In a few cases, the noun in the entry is a grammatically proper name. In these cases, the entry requires that the object designated by the proper name be described or otherwise indicated. For example, 'Who was Paul Elmer More?' is a question which asks that the person referred to be described unambiguously.

Finally, some entries ask for a term or expression that can be substituted for another term or expression; for example, 'What is the symbol for gravity?'.

2) Describing. To describe is to represent something by words or drawing, to tell about something. Thus, the entries making up this category mention or suggest something and require that an account of this something be given. In the question 'What can you tell us about the gill rakers?' we are asked to describe the gill rakers.

However, not all questions which mention or allude to something ask for a description. For example, 'What would be some examples of a sense organ?' is a question which names a class of things and asks that instances of it be cited. No description is called for.

In some cases, as in the example just given, it is easy to tell whether the entry requires a description or an identification. But in a large number of entries the intent of the entry in this regard is obscure. 'What did Cleveland find out?' is a question which might be answered by naming whatever it was that Cleveland uncovered. But our expectations would be more nearly satisfied were the question answered by a brief account of what he found out. On the other hand, 'What is a common defect of this part (cerebellum) of the brain?' can plainly be answered by naming the defect. But a description of the defect would not be inappropriate as an answer.

3) Designating. To designate is to identify something by name -- word or other symbol. The name designated the object (abstract or concrete) to which it refers. Thus, this group of entries is made up of items in which something is described or otherwise indicated, and the name used to refer to it or to identify it is asked for. These entries vary widely in form and content. In general, they demand that objects (abstract or concrete) be designated by name or other symbol, or simply by pointing. Consider the question 'What do you call a word used to modify a verb?'. The question is answered by giving the name of the word, namely, 'adverb'. The question 'What reptile did he show in the film?' is answered in the same way, although the question does not explicitly ask what the reptile is called. Again, 'What is the word (in a given sentence) that's to be modified?' is a question which can be answered by pointing to the particular word or by saying it.

4) Stating. Entries in this group do not ask for names, descriptions, etc., but for statements of issues, steps in proofs, rules, obligations, theorems, conclusions, ideas, beliefs, promises, threats, etc. For example, the question 'What is the conclusion?' asks for a statement of some sort. It can seldom be answered satisfactorily merely by naming.

5) Reporting. The entries in this group ask for a report on what a book or document

says, for information in the text, or for a summary or review, and the like.

6) Substituting. The entries making up this category ask the student to perform a symbolic operation usually of a mathematical nature.

7) Evaluating. To engage in evaluating is to estimate the worth, dependability, etc. of something. An entry of this type requires that some object, expression, event, action, or state of affairs be rated as to its value, dependability, desirability, and the like. For example, the question 'Is he a good judge?' asks the student to rate a judge who acts in some particular manner.

8) Opining. In opining, the body of evidence from which the conclusion is drawn is not explicitly delineated by the entry of the episode, i.e., no explicit conditions are given on which the conclusion is to be based. The person may be required to supply that which is the case, or to affirm or deny what is suggested in the entry as being the case. It is characteristic of such episodes that the conclusion involves an inference from evidence rather than a report of a single fact. 'Do you think that historians will say that Wilson was right in proposing the League of Nations?' is an entry which asks for a conjecture about how historians of the future will judge Woodrow Wilson with respect to a particular set of actions -- those involved in proposing the League of Nations.

9) Classifying. Each entry in this group makes explicit reference to an instance or class (type, sort, group, set, kind) of things or both. The entry requires that a given instance be put in the class to which it belongs, or that a given class be placed in a larger class to which it belongs as a subclass. For example, 'What special type of triangle did you find it to be? ' is a question which makes reference by the 'it' to a particular triangle. The student is expected to tell what class of triangles this particular one belongs to. As an illustration of questions which ask that a class be placed in a larger class, consider the following: 'What group of animals does the jellyfish belong to?'. In this question the term 'jellyfish' does not refer to a particular jellyfish but to a subclass. The student is required to name the larger class to which the group of animals called 'jellyfish' belongs.

10) Comparing and Contrasting. This type of entry requires that two or more things -- actions, factors, objects, processes, etc. -- be compared. In some cases, the entry specifies two or more things, and asks that either their similarities or differences be noted. In other cases, the entry asks that they be compared with respect to a particular characteristic. The question 'What's the difference between probation and parole?' illustrates the first of these cases. The student is asked merely to make a comparison, the points of comparison not being explicitly indicated. The second case is illustrated by the question 'Is his (fish's) eye very large compared to the size of the grasshopper's?'. Here the eyes of the two different animals are to be compared with respect to size only.

In still other cases, the entry names a thing and requires that another thing similar to it, be indicated. Consider the question 'Which one (Canadian house) corresponds to the House of Commons?'. The House of Commons is the given object. The question asks that the Canadian house most like it be named. Entries of this kind do not require that differences or similarities be explicitly stated. The student considers the differences or likenesses and selects the object in terms of them, as required by the entry.

11) Conditional Inferring. These entries contain an antecedent, that is, the conditional part of a statement. In the sentence 'When it rains, the streets are wet' the phrase 'when it rains' is the antecedent. The phrase 'the streets are wet' is the consequent. Now, the entries which make up this category give an antecedent. Sometimes they give both an antecedent and a consequent. But they never contain a consequent alone.

Here is an example of an entry containing an antecedent only: 'How does that (undemocratic handling of colonies) affect the mother country?'. The phrase 'undemocratic handling of colonies' is the antecedent. It describes the condition of which the effect on the mother country is the consequent. The question asks the student to tell what the consequent is. Take another case: 'If that diagonal (in rhombus) is given as 12 and this angle is 60, what is the angle at C and at A?'. The antecedent is ' if that diagonal (in rhombus) is given as 12 and this angle is 60'. The consequent asked for by the question is the size of the angle at C and A. In all cases where the antecedent alone is given, the entry requires that the consequent -- effect, result, outcome, subsequent behavior, etc., -- be supplied as the answer.

Consider an example of an entry containing both an antecedent and a consequent: 'Did you ever get a headache from sleeping in a draft?'. The phrase 'sleeping in a draft' is the antecedent, and 'get a headache' is the consequent. Now, in entries of this sort, the student is required to affirm the consequent, to deny it, or to say he does not know whether he has ever suffered or enjoyed the consequent under the given condition or not.

12) Explaining. There are several types of explanatory entries, but they all have one thing in common. They give a particular consequent and they require that an antecedent be supplied. To explain is to set forth an antecedent condition of which the particular event or process to be explained is taken as the effect, or else, to give the rules, definitions, or facts which are used to justify decisions, judgments, actions, etc. In the example 'Why did the light go out?', the consequent is 'the light go out.' The question asks the student to give a reason (reasons) to account for the fact that the light is out. The reason(s) is the antecedent.

There are six kinds of explanation entries depending upon the sort of antecedent used to account for the consequent. They are mechanical, causal, sequent, procedural, teleological and normative. These are described as follows:

12.1) Mechanical Explaining. This type of entry gives an event or action which is to be accounted for by describing the way the parts of a structure fit or work together. A sample entry will help to make this category clear: 'How (do fish make a sound)?'. The action to be accounted for is 'fish make a sound.' Now, the antecedent consists of some kind of structure which enables the fish to make vibrations. A description of this mechanism would constitute an answer to the entry.

12.2) Causal Explaining. Entries of this type give events situations, or states to be accounted for and ask that a state of affairs be cited of which the given event (or situation or state) is taken to be the result. Consider the example: 'What makes a person's muscles sort of twitch-like?'. The event to be explained is the twitching of a person's muscles. The explanation consists of a description of the condition of the nerves associated with the twitching.

12.3) Sequent Explaining. Entries of this sort ask how something happened. They require that a sequence of events be cited of which the event to be accounted for is the sequel. For example the question 'How did McKinley happen to be killed?' requires the recitation of the events leading up to the assassination of President McKinley.

12.4) Procedural Explaining. These entries require that the steps or operations by which a given result or end is attained be described. Here is a sample entry: 'How did you get 72 (for an answer)?'. It is expected that the student tell the steps he took to obtain this answer.

12.5) Teleological Explaining. This type of entry contains descriptions of actions, decisions, states of affairs, or the worth of things. It requires that these be accounted for or justified by reference to purposes, functions, or goals. An entry of this sort is: 'Why are you doing those problems?'. The consequent to be explained is 'doing those problems.' The explanation consists in giving a purpose, say, to satisfy an assignment.

12.6) Normative Explaining. Entries of this type do either of two things. First, they may mention or assume a decision, judgment, or state of knowing and require that it be justified by citing a definition or characteristic or both. Here is an example: 'Why do we call them (animals between vertebrates and invertebrates) the Chordata animal group?'. The consequent is the underscored part of the question. To give the antecedent in this case is to cite a definition of the chordata phylum and to point out that the animals in question have the characteristics called for by the definition.

Second, members of this group of entries cite actions, decisions, or choices (either made or to be made) and require that rules be given as reasons for the decisions, choices, etc. Consider this example: 'Why do we use shorter (in comparing two pencils as to length)?'. The consequent to be explained is 'we use shorter.' The antecedent demanded by the question consists of a rule prescribing the use of 'shorter' in such cases. Entries of this type usually call for grammatical or mathematical rules.

13) Direct~~or~~ING and Managing Classroom. Many entries have little or no logical significance. They are designed, not to evoke thought, but to keep the classroom activities moving along. Such entries belong in this category.